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THE OSTIUM MAXILLARE

ANATOMIC STUDY OF ITS SURGICAL ACCESSIBILITY

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Probing the natural orifice of the maxillary sinus is the routine practice of some rhinologists, whereas there are many who seldom attempt this method of approach to the antrum. The latter group, representing no doubt a vast majority, usually irrigate the sinus through an artificial opening in the wall of the inferior meatus. The reasons for their preference are: 1. They have difficulty in locating the natural ostium in a large percentage of cases. 2. The sinus cannot be properly flushed out when the return flow is partially blocked by the cannula. 3. Instrumentation of the ostium injures and inflames its membranous lining. 4. The search for the orifice irritates the soft structures of the middle turbinate and the outer nasal wall, producing congestion in the middle meatus, with further blocking of drainage. 5. Spread of infection to the ethmoid labyrinth or even to the orbit is possible, especially if the cannula is out of place during irrigation. 6. Diagnostic lavage has not the value because of the uncertain location of the tip of the cannula.

On the other hand, the rhinologists who practice cannulization of the normal ostium maintain it to be by far the simpler method. Occasionally the tip of the cannula drops readily into the orifice, causing little annoyance to the patient, and this may be regarded as highly important, especially as the irrigation may have to be repeated. They regard probing with a dull-tipped cannula less dangerous than puncture through the bony wall, which necessitates the use of a sharp-pointed instrument. Another reason for their preference is the occasional thickness of the naso-antral wall, which in some instances seems almost impenetrable to the ordinary needle or trocar. Then, finally, they maintain that with practice they are able successfully to catheterize and irrigate the maxillary sinus in a large majority of cases and may always resort to puncture if necessary.

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A third group of rhinologists deliberately puncture the membranous wall of the middle meatus when they fail to engage readily the natural or an accessory aperture. They use for the purpose a cannula having a semisharp tip, and they maintain that through the opening thus made the sinus may be irrigated with comparative safety.

Opposing this procedure are those who disapprove artificial openings in the neighborhood of the maxillary ostium, holding that there is danger of formation of scar tissue in the lining of the sinus. The denuding of such tissue of cilia causes a break in the ciliary stream on its way to the natural exit of the sinus. There are also those who appreciate the proximity of the orbit and consequently hesitate to exert pressure against the wall of the middle meatus.

REVIEW OF THE LITERATURE

Writers disagree as to the accessibility of the ostium maxillare. Those who clinically practice sounding the opening, maintain that they can successfully catheterize from 80 to 85 per cent of their patients. Other writers, basing their conclusions on anatomic findings, say that in no more than 25 per cent may the sinus be entered with ease and without injury to surrounding structures.

In an article published in 1932 Dintenfass [1] called attention to the simplicity of puncture with a Lichwitz needle and also to the dangers: air embolism, hemorrhage, shock, pain, emphysema and inflammation of soft parts, and obstruction of the needle. These, he stated, are eliminated in probing, although this method has its limitations, such as the presence of a deviated septum, a low middle turbinate or an overhanging bulla. If the uncinate process is over 5 mm. high, the ostium is hidden, and when the infundibulum is narrow, failure may result. Irrigation is difficult if the return flow is obstructed, and if the ostium is too large the cannula slips out. If the procedure is repeated too often, inflammation ensues, closing the ostium. He stated that the ostium is not really an opening like a doorway, but is like a canal pointing laterally, downward and forward.

In 1932 Myerson [2] also reported the results of his study of the maxillary orifice in 114 skulls. In 14 of these the ostium was hidden by the high obstructing wall of the uncinate process. In 15 he found it impossible to probe the sinus with the Yankauer or the Pierce cannula. In another paper, published four months later, the same author [3] dealt with the clinical aspect of the subject. He stated that he successfully

1. Dintenfass, H.: Inferior Meatal Puncture Versus Catheterization of Natural Orifice, Laryngoscope **42**:943-995 (Dec.) 1932.

2. Myerson, Mervin: The Natural Orifice of the Maxillary Sinus: I. Anatomic Studies, Arch. Otolaryng. **15**: 80-91 (Jan.) 1932.

3. Myerson, Mervin: Natural Orifice of the Maxillary Sinus: II. Clinical Studies, Arch. Otolaryng. **15**:716-733 (May) 1932.

cannulized 81 per cent of his living subjects. He quoted Skillern, who said: "Natural ostium cannulization is not practical," and Schaeffer, who said: "It is impossible in the vast majority of cases." He also quoted Zukerkandl, Sieur and Jacob, who stated years ago that it is entirely superfluous to tire oneself in sounding the natural opening. Schaeffer, in discussing Myerson's paper, said that he felt that the accessory ostium as well as puncture of the membrane was more often used.

Hajek,[4] in his work on nasal accessory sinuses, said: "In a certain group of cases the infundibulum and ostium maxillare are accessible for sounding. In individual cases the introduction of the cannula may be very difficult or impossible. In some cases if the outlet is narrow, the lavage will not be effective. Pus of the clump type will remain in the antrum even after repeated irrigations, therefore, the general practical use of this simple and efficient method may not be applicable."

Mosher[5] in 1929 said: "It is difficult if not impossible in the majority of cases to catheterize the ostium of the antrum. From the surgical standpoint, however, this makes but little difference, because it is easy to break into the antrum near the ostium through the membranous area in which the ostium is placed."

A year later Harry Neivert[6] spoke similarly, saying: "In the membranous wall we find accessory openings and it is quite possible that a cannula passed to the antrum by way of the middle meatus enters through the attenuated membrane." Neivert advocated removal of the uncinate wall to improve drainage from the natural opening and infraction of the middle turbinate when necessary. He also advised the use of an endoscope for inspection of the middle meatus.

Harmon Smith,[7] in 1930, referring to the nonsurgical consideration of empyema of the maxillary sinus, stated that he advocates first the use of such aids as tampons and suction. If this treatment fails, he endeavors to irrigate the antrum through the natural opening by means of a small, curved, blunt-pointed cannula attached to a metal syringe. In a large majority of cases this effort is successful. Also in 1930, Imperatori[8] said: "The catheterization of the maxillary sinus through

4. Hajek, M.: Pathology and Treatment of the Inflammatory Diseases of the Nasal Accessory Sinuses, St. Louis, C. V. Mosby Company, 1926, vol. 1, p. 293.

5. Mosher, H. P.: Surgical Anatomy of Ethmoidal Labyrinth, Tr. Am. Acad. Ophth. **34**:376-410, 1929.

6. Neivert, Harry: Surgical Anatomy of the Maxillary Sinus, Laryngoscope **40**:1-4, 1930.

7. Smith, Harmon: Nonsurgical Consideration of Empyema of the Maxillary Sinus, Laryngoscope **40**:5-6 (Jan.) 1930.

8. Imperatori, Charles J.: The Intranasal Treatment of Suppurative Disease of the Maxillary Sinus, Laryngoscope **40**:7-9 (Jan.) 1930.

the normal opening can be safely, easily, and more or less painlessly done."

The wide divergence of opinion as to the accessibility of the orifice would indicate that definite knowledge on the subject is lacking. An understanding of the nature of the maxillary sinus and its intranasal connections is possible only when founded on a knowledge of the basic anatomic structure of the outer nasal wall. Such knowledge is best obtained by a careful study of a large series of specimens from cadavers and should include a familiarity with the area in its various stages of development from early embryonic life to maturity.

ORIGIN AND DEVELOPMENT OF THE MAXILLARY SINUS

The structures most intimately associated with the origin and development of the maxillary sinus are the uncinate process, the ethmoid infundibulum, the membranous nasal wall and the lateral cartilaginous plate. The infundibulum and the structures about it appear early in embryonic life as slight irregularities on the outer wall of the middle meatus. In a 3 month fetus the rudimentary uncinate process appears as a ridge on the superior surface of the inferior turbinate (fig. 1). Lateral to this ridge lies the infundibulum, which at this age is a well developed groove. In the depths of this groove during the third fetal month the maxillary sinus takes its origin. The original bud consists of an evagination, or outpouching, of mucous membrane and in effect is merely a downward extension of a portion of the infundibulum. The space occupied by this original cell, or pouch, forms the ostium maxillare, and as such it persists throughout life. The location of the ostium in the infundibulum, its size and shape and the direction it assumes all have considerable bearing on the ultimate character of the naso-antral connections.

The development of the antrum proceeds steadily through the first few months. Coronal sections from a 4 month fetus (fig. 2) show the sinus present in the membranous wall of the nose, its inferior border in close approximation with the attachment of the inferior turbinate.

Extension laterally soon brings the sinus into contact with the lateral cartilaginous plate, and at the same time it expands inferiorly to occupy the space formed by the fusion of the lateral plate with the cartilage of the inferior turbinate (fig. 3).

Absorption of cartilage permits further expansion, and before birth the sinus has commenced its invasion of the maxilla. At birth, although it still has the appearance of a slitlike recess, it is the furthest developed of all the nasal air cavities and is the only one which may be regarded as being more than rudimentary.

During the early years of postnatal life progress is comparatively rapid. As the maxilla increases in size, there is a corresponding increase in pneumatization. This proceeds for eight years at an approximate rate of 2 mm. each year vertically and laterally and 3 mm. anteroposteriorly.[9] The expansion is less rapid in the lateral and vertical direc-

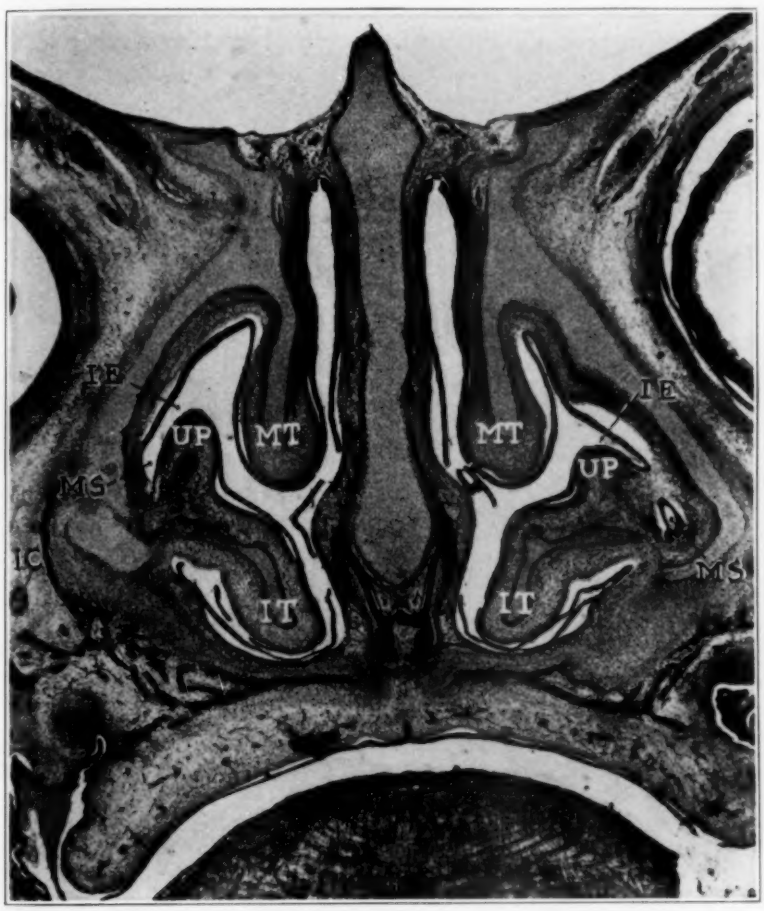

Fig. 1.—Photomicrograph of a coronal section through the nose of a fetus aged 3.3 months. This section shows the right and left sides of the nose cut in slightly different vertical planes. The right is in a plane which shows the ostium maxillare as well as the primitive sinus. The left shows the posterior tip of the sinus. *MS* indicates the maxillary sinus, *IE* the infundibulum ethmoidale, *UP* the uncinate process and *IC* the infra-orbital canal. About ×7.

9. Davis, Warren B.: Nasal Accessory Sinus in Man, Philadelphia, W. B. Saunders Company, 1914.

tions (fig. 4 *A*) owing to the close relation of the developing teeth to the orbit. Laterally, progress is noted by the ever changing relationship of the sinus with the infra-orbital canal. This canal in the early fetal months lies lateral and inferior to the primitive antrum (figs. 1, 2 and 3). During the second year the sinus reaches the canal, and in the third or the fourth year it has passed beneath and beyond it (fig.

Fig. 2.—Photomicrograph of a coronal section through the nose of a fetus aged about 4 months. This section, taken in the plane of the ostium maxillare, shows the early extension of the sinus in the membranous wall. *MS* indicates the maxillary sinus, *UP* the uncinate process, *IE* the infundibulum ethmoidale and *IC* the infra-orbital canal. Approximately ×9.

4 *B*). In the anteroposterior diameter the advancement is more rapid, and early the sinus assumes an ovoid appearance (fig. 4 *A*). At birth it has a size and shape somewhat resembling that of a small lima bean. Its lower border at that time is approximately 4 mm. above the nasal floor. At 8 or 9 years the floors are in the same horizontal plane (fig.

4 *C*), while in the adult the floor of the sinus is usually the more dependent by 4 or 5 mm. In the transverse diameter the limit of expansion is reached about the ninth year, when the sinus penetrates the malar bone (fig. 4 *C*). From that time on progress is slow and ceases entirely at about the fifteenth year, except for the posterior inferior

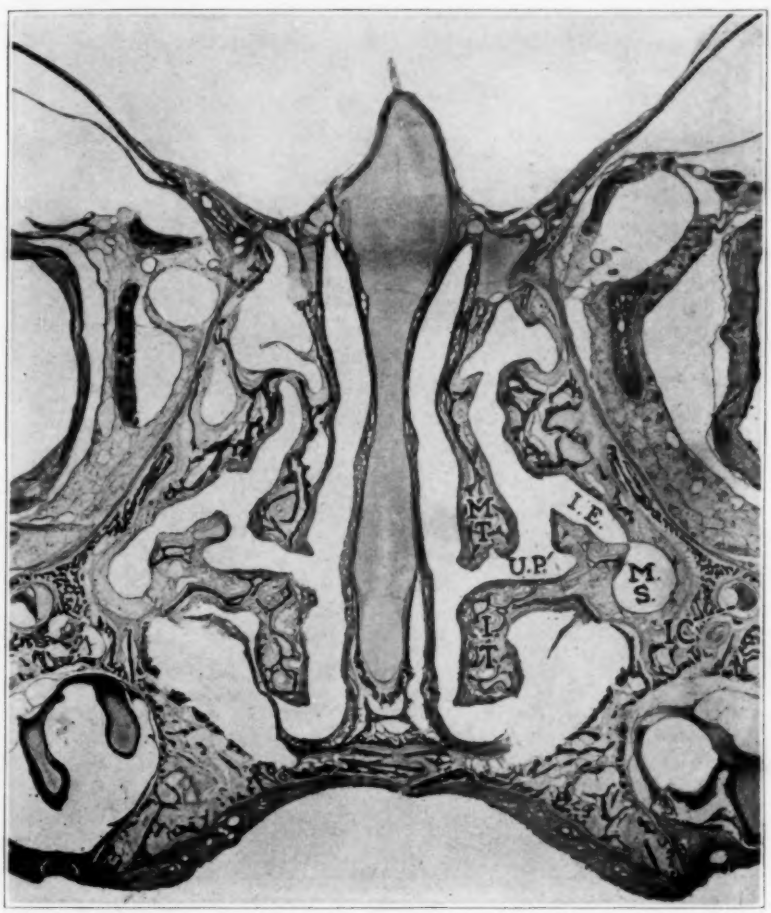

Fig. 3.—Photomicrograph of a coronal section through the nose of a fetus, aged about 6 months. *MS* indicates the maxillary sinus, *IE* the infundibulum ethmoidale and *UP* the uncinate process. Approximately × 5.

angle, which descends after the eruption of the third molar tooth (fig. 4 *D*). The mature cavity averages 34 mm. in length, 23 mm. in width and 33 mm. in depth. The shape is pyramidal, with a quadrilateral base, which is represented by the naso-antral wall, the apex extending transversely into the zygomatic process.

The naso-antral connections are made through the wide space in the maxillary bone, known as the hiatus maxillaris. Laminae from adjoining bones partially fill in the hiatus (fig. 5), and the whole is covered with nasal mucous membrane. This membrane fills in the intervals between the osseous processes and passes through the ostium

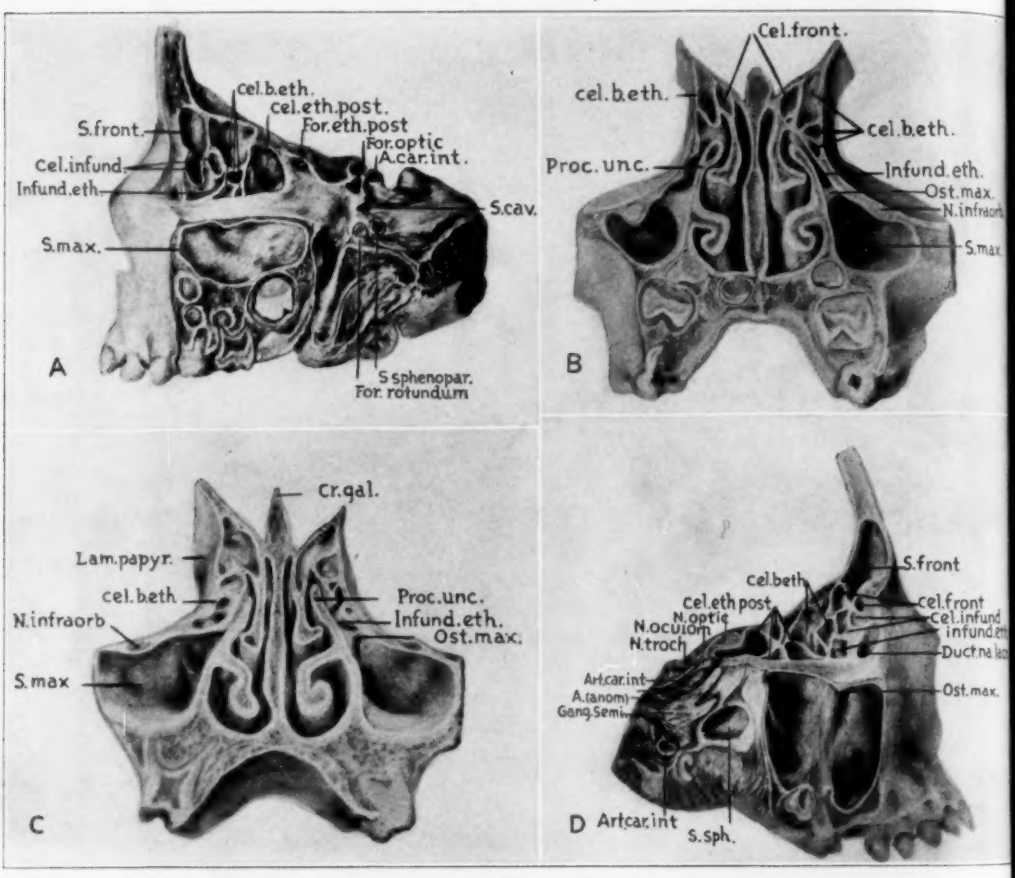

Fig. 4.—Drawings by Davis,[9] showing various stages of the development of the maxillary sinus. *A*, lateral view of the maxillary sinus of a child aged 2 years and 6 months. This shows the ovoid appearance of the early sinus. Expansion inferiorly is being delayed by the developing tooth buds. *B*, coronal section of the nose of a child aged 4 years, 7 months and 19 days, showing the lateral extension of the antrum beyond the infra-orbital canal. *C*, coronal section of the nose showing the maxillary sinus at the age of 9 years and 10 months. At this age the sinus has reached its limit of development in the transverse direction. *D*, lateral view showing the antrum at the age of 15 years and 9 months. At this age the sinus is mature except for the posterior inferior angle, which will descend after the eruption of the third molar.

maxillare to become continuous with the lining of the sinus. Absence of the duplicated membrane in isolated areas accounts for the occasional accessory aperture.

During the two years prior to the time of writing an investigation was made of all available cadavers in the anatomic laboratory of the University of Illinois. One hundred and sixty-three adult specimens and several fetal heads of various ages were studied. The heads were divided in the midsagittal plane; the middle turbinate was pushed out

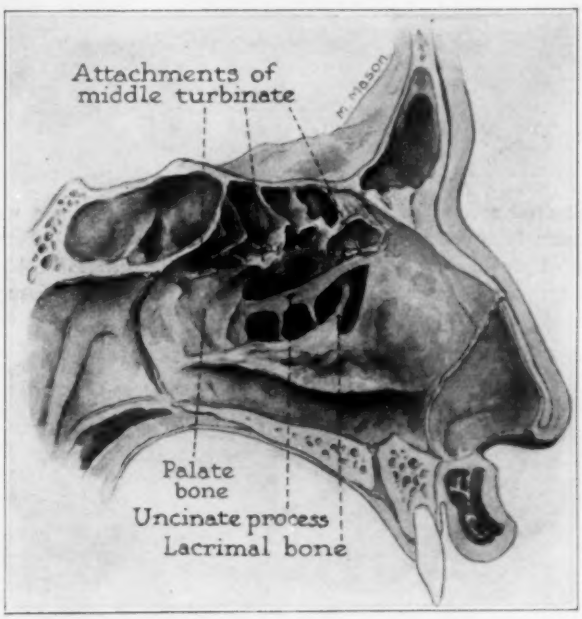

Fig. 5.—Sagittal section of the nose. The middle turbinate has been removed, exposing its attachments to the nasal wall. The lining membranes of the nose and sinus have been removed, exposing the nasal fontanel. The hiatus maxillaris is shown partially filled in by osseus laminae from the neighboring bones.

of place, and in many specimens the outer wall of the antrum was removed to facilitate examination of the ostium. The study was made not only of the maxillary orifice but of the neighboring structures as well.

The ostium was observed as to its location in the infundibulum, and the height of the uncinate wall was measured at a point opposite the ostium. Walls of more than 4 mm. were regarded as high, while those having a height of 2 mm. or less were tabulated as low. The width of the hiatus semilunaris was noted. If there was insufficient space between the uncinate process and the bulla to admit the passage of the

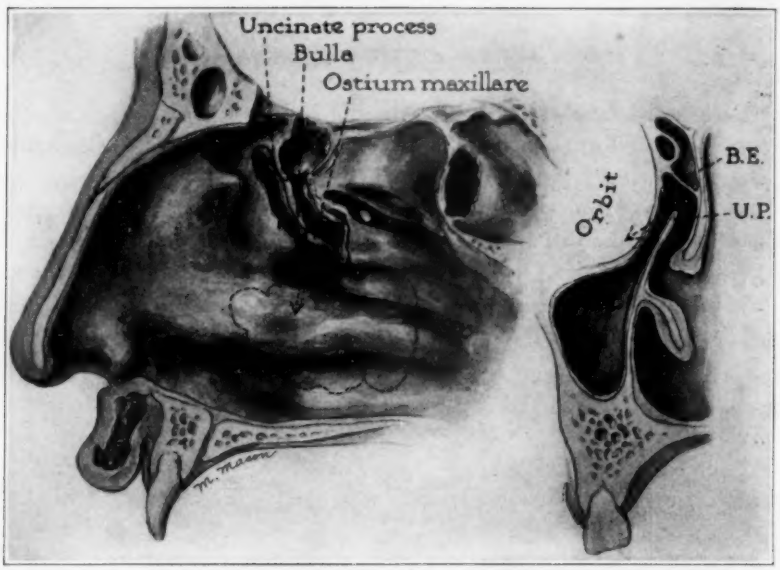

Fig. 6.—Sagittal section of the nose, showing a high uncinate wall with the maxillary ostium lying deep in the infundibulum. The frontal view shows the inaccessibility of the ostium and the proximity of the orbit. Probing in specimens of this type could easily result in penetration of the lamina papyracea.

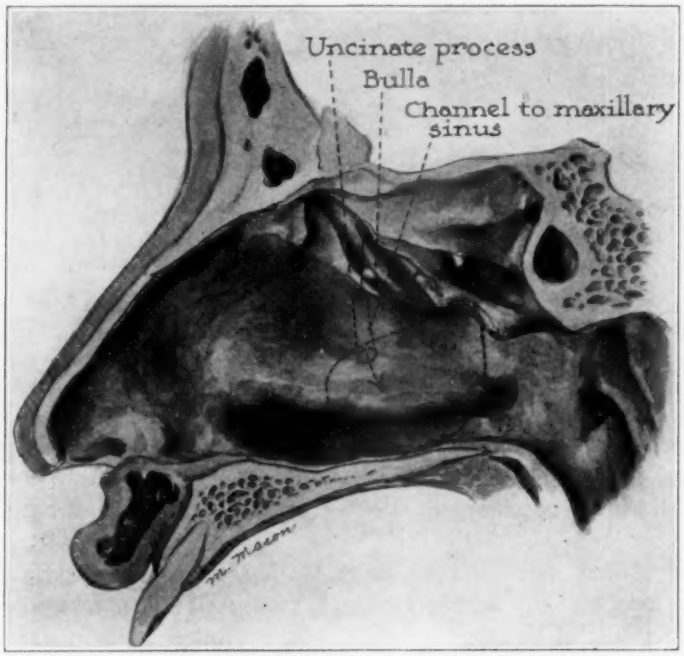

Fig. 7.—This specimen shows an inaccessible ostium maxillare. A channel 13 mm. in length extends from the floor of the infundibulum to a small antrum. The hiatus semilunaris is too narrow to admit the passage of an average-sized cannula.

average-sized cannula, the hiatus was regarded as narrow. Occasionally a wide, easily accessible hiatus was observed (figs. 8 and 9). Measurements of the accessory ostia were made and recorded. The bulla and the middle turbinates were studied as to the possibility of their blocking the entrance to the hiatus. Deviation of the septum, although a clinical entity, is not considered in this report, owing to the absence of the septum in most of the specimens examined.

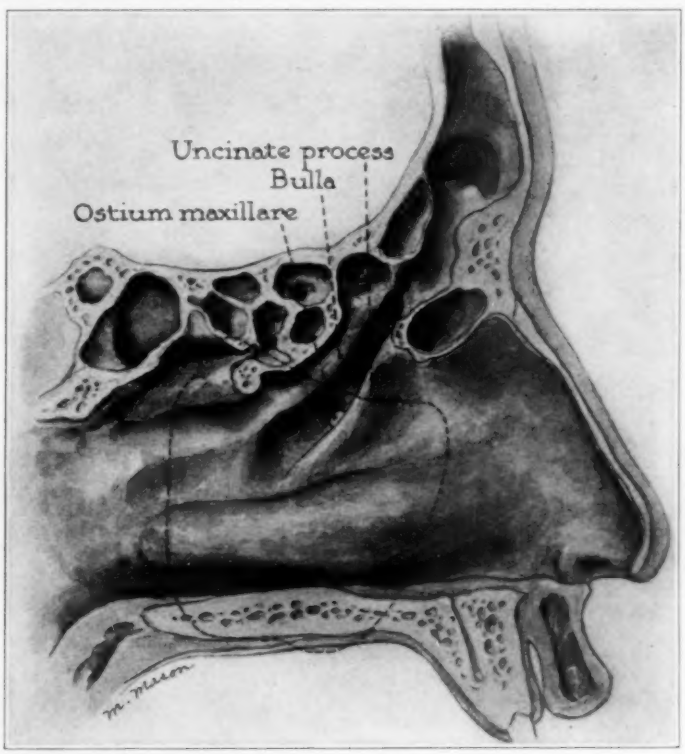

Fig. 8.—This specimen shows a wide hiatus semilunaris and a low uncinate wall. The ostium maxillare, which is located in the posterior third of the infundibulum, could be easily reached by a probe or a cannula.

Finally, all were charted as to possibilities for probing during life and classified as impossible, possible but difficult, easy and easy if an accessory ostium were available.

ANATOMIC OBSERVATIONS

Of the 163 specimens, 9 had their opening in the anterior third of the uncinate groove, 18 in the middle third and 117, or 71.8 per cent, in the posterior third, while in 19 cases the ostium was visible,

being located at the extreme posterior tip of the uncinate groove. The 19 visible openings were in most instances regarded as easy to sound.

The uncinate wall was high, with the ostium buried deep in the infundibulum (figs. 6 and 7) in 41 cases, or 25 per cent, and in all these probing would be difficult or entirely impossible in the living subject. The wall was noticeably low in 8 cases (figs. 8 and 9). In spite of the low wall, one ostium was difficult to reach because of a narrow hiatus. One specimen, not considered, showed the result of

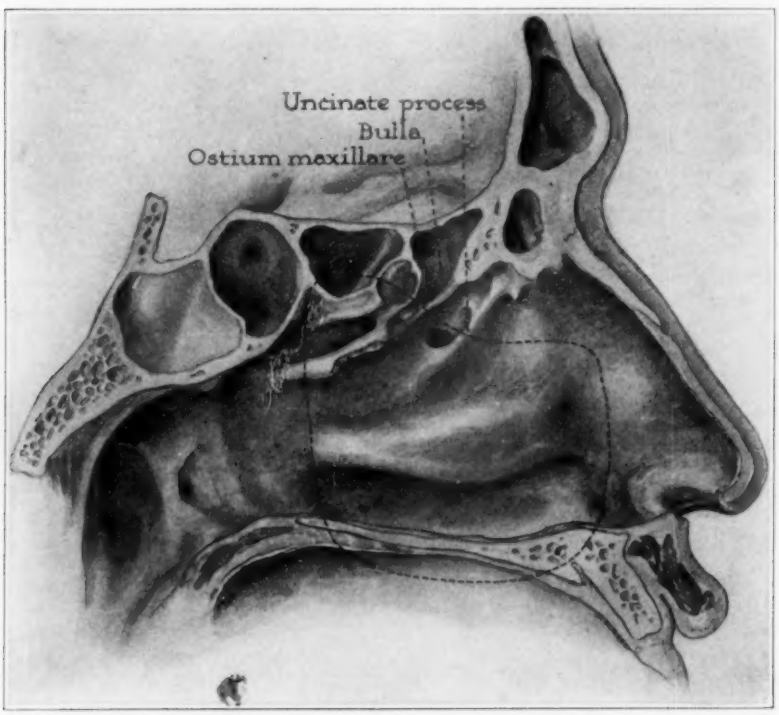

Fig. 9.—The ostium maxillare in this specimen is located at the extreme posterior tip of the infundibulum. As in the specimen shown in figure 8, the hiatus semilunaris is wide, the uncinate wall is low and the ostium is easily accessible.

bilateral intranasal surgical intervention, no trace of the uncinate process being present on the left side, while on the right it had been fractured medially.

The ostium was blocked by a narrow hiatus semilunaris (fig. 7) in 18 cases and by a low overhanging bulla in 12 (fig. 10). In 1 specimen of the latter group a cystic middle turbinate was present to further impede access to the ostium.

In 28 cases the middle turbinate was low and of sufficient bulk to render probing impossible or extremely difficult. In 1, adhesions were present between the turbinate and the wall, making probing difficult. In 7 specimens atrophy was present, and in many the lower border of the turbinate was on a level with or above the ostium; these were usually regarded as easy to catheterize.

Thirty-seven of the 163 specimens, or 23 per cent, had accessory apertures (figs. 10 and 11). Multiple openings were present in 5 specimens, one having three, and 4 having two each (fig. 11). These findings perhaps strike an average range, the estimates of different observers

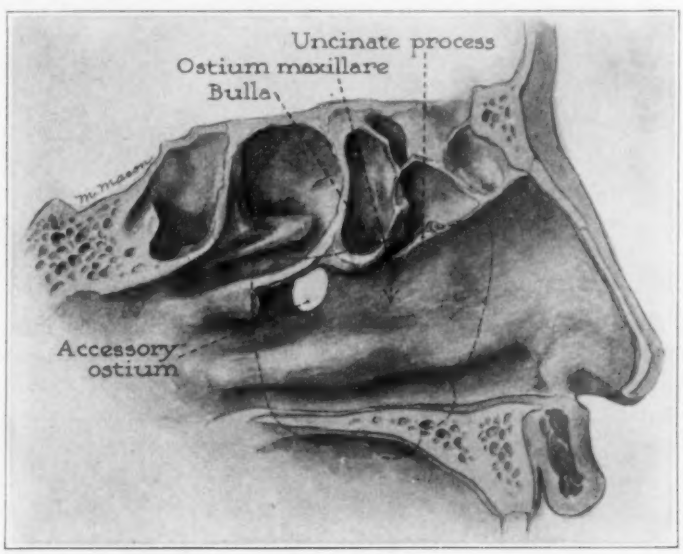

Fig. 10.—Specimen with a low overhanging bulla. When the anatomic structure is of this type, the ostium maxillare may be reached but with difficulty. A large accessory ostium is available for probing in this specimen.

varying from 10 per cent to 50 per cent. Myerson found accessory openings in 30.7 per cent of specimens, Schaeffer in 43 per cent and Neivert in 25 per cent. Davis found them less often in children, reporting 15 per cent in his series of 114 cadavers. The presence of these extra apertures is important in the final analysis of any group of specimens, for many of them may then be classified as easy to probe in which without the accessory ostium probing would be impossible or difficult.

In one specimen a double antrum was observed (fig. 12). Two ostia were present, one visible at the tip leading to the smaller of the two sinuses, the other hidden in the posterior third of the infundibulum leading to a larger cavity. Probing in this case would undoubtedly

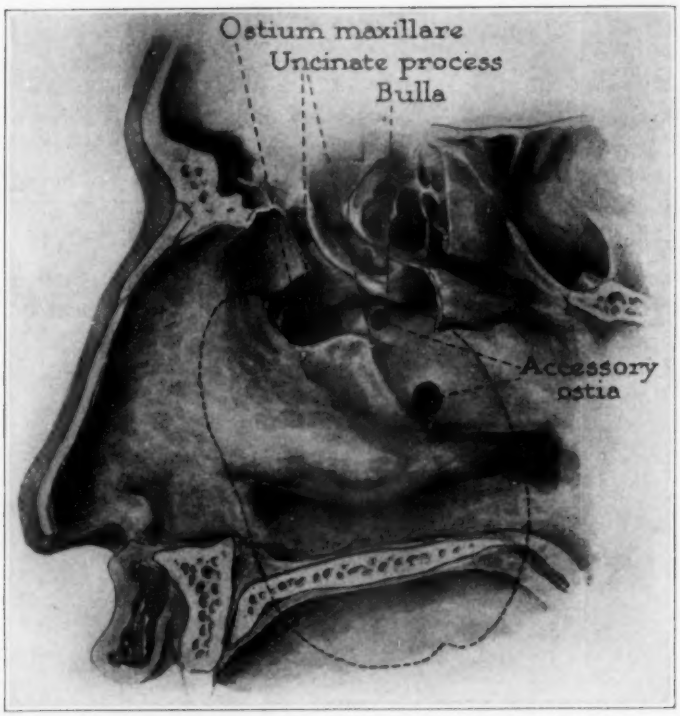

Fig. 11.—Specimen with multiple accessory ostia. The ostium maxillare in this instance is located in the middle third of the infundibulum. Its entrance is blocked by a high uncinate wall.

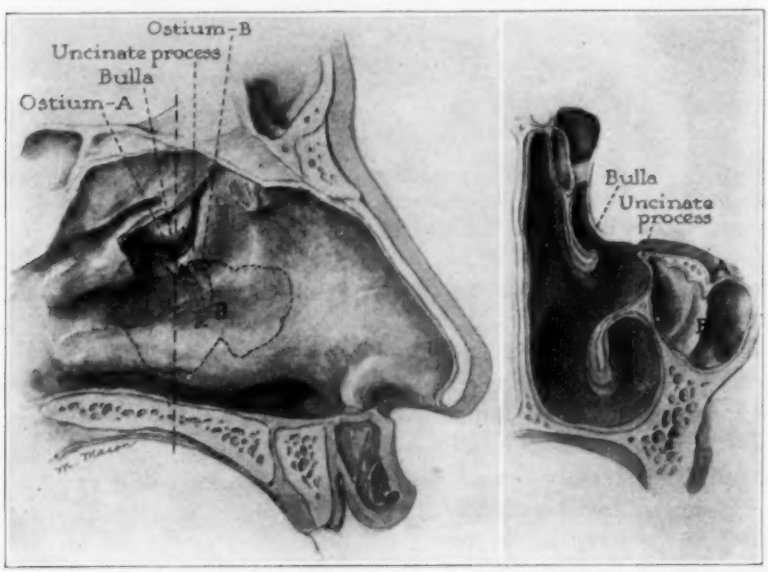

Fig. 12.—Specimen with a double maxillary sinus. A probe in this specimen would undoubtedly reach the ostium *A*, the opening to the smaller cell. Ostium *B* is inaccessible, and cavity *B* could be reached only by puncture.

produce contact with the more accessible of the two ostia, the one leading to the smaller cell, whereas a puncture of the inferior meatus would penetrate the larger cavity.[10]

In the group studied it was impossible to cannulize 31, or 19 per cent, of the 163 specimens through the natural orifice. Nine of these, however, had accessory openings, which from a clinical standpoint lowered the number of those in which cannulization would be impossible to 22, or 13.5 per cent. Sixty-eight were regarded as difficult but possible to cannulize, and 16 accessory openings in this group brought the total down to 52, or 31.9 per cent. The total of those having easily accessible natural openings was 64, or 39.3 per cent. With those may be included the 25 with available accessory apertures, which brings up the total of those easy to probe to 89, or 54.6 per cent.

COMMENT

Clinical case reports do not come within the scope of this paper, which is merely a record of anatomic investigation. Clinical data on this subject to be of value would require painstaking observations during the treatment of an extensive series of selected cases. These would of necessity be instances of bilateral maxillary sinusitis, the involvement being of a similar nature on the two sides. The treatment should evoke the use of the cannula for one antrum and the trocar for the other. Without corroborative clinical evidence it is impossible to make irrefutable statements as to the respective merits of one method of irrigation of the antrum over another. One may formulate conclusions, however, after a careful evaluation of anatomic observations. These are merely deductions and may be of little value in the face of controversial clinical evidence.

The anatomic findings reported conform largely with those made by other observers, and in so doing fail to justify the reports of clinicians who practice catheterization of the ostium maxillare. In the final analysis of the specimens an effort was made to depart from the purely anatomic point of view and to visualize the structure in each case as it would appear in the living subject. Living structures, it is realized, are more resilient than the half-dried specimens from cadavers. The thin bony strip which supports the uncinate wall will stand considerable bending in the living state without fracture, whereas in the cadaver manipulation without care may cause a tear in this wall. The same applies to the other structures about the middle meatus, and in consequence of this many ostia impossible to reach in the cadaver without

10. Figures 5 to 12 are drawings made from specimens in my collection in the anatomic museum of the Department of Otology, Rhinology and Laryngology, Department of Medicine, University of Illinois.

removal or destruction of tissue might in the living subject lend themselves readily to probing. In spite of this adjusted point of view the anatomic structure was found to be such in some cases as absolutely to inhibit contact with the maxillary ostium. The breaking down of an obstructing uncinate wall, puncture through this wall or removal of a portion of an overhanging middle turbinate or ethmoid bulla would have to be considered if the ostium were to be reached. Even then certain ostia are so protected as to defy all except extensive surgical procedures. Clinicians, then, in about 20 per cent of cases will never find the opening, no matter how proficient they are or how tirelessly they search. They may report a smaller percentage of failures, which would merely be conclusive evidence that the surgeon in his search for the ostium may unwittingly force his way through the membranous wall or enter an accessory aperture already present. In 40 per cent of cases, which includes those in which probing is regarded as difficult, a great deal will depend on one's dexterity, experience, technic, familiarity with anatomy and persistence. Those operators who practice the procedure daily become adept, and in many of the cases in which probing seems difficult to the inexperienced it is fairly simple to them. In the remaining 40 per cent the ostium is easily accessible, and in this group also fall those in which there are ostia, which raises the percentage to 54.6. In at least half the cases, then, irrigation of the antrum may be instituted without difficulty and with little annoyance to the patient, and this in itself should justify the development of a technic for the procedure. The intelligent operator, however, soon learns the limitations of cannulization. He learns that it is not well to be too persistent. Prolonged search for an elusive aperture adds to the congestion and offsets in a large measure any good which may come from irrigation. He recognizes the difficulties almost at once and does not hesitate to resort to puncture. Whether the puncture is made in the inferior or in the common meatus seems of little importance. Nor does it seem important for the operator to know that instead of locating the ostium he has in reality made an opening in the membranous wall, as long as the irrigation is successfully induced. He should realize, however, that in case he has made a puncture he can expect a better result from the operation, and that a cavity may be more thoroughly and rapidly flushed out when a stream of water is forced through it, separate apertures being used for the intake and the outflow.

CONCLUSIONS

Anatomic study of a large group of cadavers reveals the degree of surgical accessibility of the ostium maxillare.

Of a series of 163 specimens the ostium was easily accessible in 64, or 39.2 per cent. An available accessory opening was present in 37

of the remaining 99, making a total of 89, or 54.6 per cent, having an easily accessible natural or accessory ostium.

A technic for cannulization of sinuses of this type is highly desirable in the treatment of maxillary sinusitis.

In nearly half of the specimens the anatomic structure was such as to make cannulization of the antrum impossible or very difficult.

In the cases in which probing is difficult a great deal will depend on the operator's dexterity, experience, technic, familiarity with anatomy and persistence.

Prolonged search for the ostium is not advocated; the resultant irritation more than offsets the benefits of the lavage.

Puncture is advised in the cases in which probing is difficult, and this may be made in the inferior or the middle meatus with relative effectiveness.

From a mechanical standpoint, puncture is the more efficient method. A cavity may be more thoroughly and rapidly flushed out when separate openings are used for the intake and the outflow.

PRESENCE OF A HISTAMINE-LIKE SUBSTANCE IN NASAL MUCOSA, NASAL POLYPI AND NASAL SECRETION

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AND
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The many papers appearing in the literature on the etiology of nasal polypi for the most part are divided into two main schools of thought, one holding that allergic disorder is the primary factor and infection is a secondary factor in the production of polypi, and the other maintaining that the hyperplastic changes are due to a primary bacterial infection. Many earlier investigators thought that a general constitutional predisposition, either acquired or inherited, is responsible for the formation of nasal polypi. The latter view coincides with the more recent observations, which hinge on the allergic origin of edematous polypi. Accepting for the moment that all edematous mucous nasal polypi are of allergic origin and that histamine is involved in the allergic phenomenon, it would appear reasonable to assume that histamine plays a part in the production of polypoid tissue. It was in an attempt to solve this point that this work was undertaken. A comparative analysis of nasal polypi and normal nasal mucous membrane was undertaken in order to ascertain whether histamine appears in greater quantities in polypoid tissue than in normal mucous membrane. The search for histamine was extended to include allergic nasal secretions in order to determine whether the nasal discharge is a true secretion, an exudate or a transudate. Since there is histamine in the blood, as has been demonstrated, if nasal secretion is largely a transudate, then the nasal discharge should contain histamine provided histaminase, an enzyme which destroys histamine, is not present.

In his studies on the architecture of the blood vascular network in the erectile and secreting tissue of the nasal passages of the reindeer and the kangaroo Swindle [1] stated that when the veinlike arteries and the

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1. Swindle, P. F.: The Architecture of the Blood Vascular Network in the Erectile and Secretory Lining of the Nasal Passages, Ann. Otol., Rhin. & Laryng. **44**:913, 1935.

venous traps are inflated to cause erection of the mucous lining, liquid which is already in the perivascular tissue is driven into the nasal passage as a viscous discharge and that if the intravascular pressure is varied in a rhythmic manner the viscous discharge is followed by a watery one, as water is filtered through the walls of some blood vessels and then urged into the nasal passages. (Swindle suggested that this is similar to the nature of the discharge from the nose of man in the course of the common cold.) He stated that the viscous portion is already outside the blood vessels and is merely forced into the nasal passages when the arteries and venous traps are inflated. He explained that during the life of the animal, when pulsatile variations of the intravascular blood pressure occur, some of the liquid of the blood seeps through the walls of some of the vessels and the water of this filtrate is carried away by the air current in the nasal passage. Then only the more viscous part of the filtrate remains to be forced out of the tissue when the arteries and venous traps are strongly inflated after death. He continued that it is unnecessary to attempt to explain any part of the nasal discharge of a dead animal in terms of the vital activity of the secretory cells in the membrane, because similar results were obtained by inflating the head of a reindeer after the head had been frozen for six weeks. He claimed that the discharge should follow the expansion of the veinlike arteries before as well as after death. Unfortunately, he did not attempt to identify the viscous substance. In view of the work of Florey,[2] it is suggested that the viscosity of the discharge was due to the preformed mucin in the secretory glands and goblet cells, which would be washed out by the mechanical process that Swindle described. Florey, in studying the secretion of the goblet cells in the intestines of the cat, reported that the secretion of the goblet cell is essentially a passage into solution of its concentrated mucin content. To effect this, water from the blood stream must pass through the cell into the lumen of the intestine. In edematous conditions (as in cyanide poisoning) in which oxygen is not available to the cell, the goblet cell is not capable of adding water to its mucin content. Florey said that the actual solution of mucin granules is a physical process and that stimulation (any kind of inflammation) results in increased permeability, permitting a stream of water to be passed through the cell. Surely death (altered permeability) would permit water to pass through the goblet cells and the mucous glands and to wash out the mucin, thus giving a viscous discharge like that reported by Swindle.

Histamine or a histamine-like substance has been found to be widely distributed in mammalian tissue since the excellent study was made by

2. Florey, H.: The Mechanism of Goblet Cell Secretion in the Mammal: The Effects of Cyanide, Brit. J. Exper. Path. **13**:301, 1931.

Barger and Dale [3] on its remarkable physiologic properties. The small intestine,[3] spleen,[4] lung,[5] liver,[5] and heart [5b] of the ox, the intestinal mucosa,[6] liver,[5b] and lung [7] of the dog, the lung of the horse [8] and the cat,[7a] the liver of the pig and sheep [5b] and the skin [9] have been reported to contain histamine or a histamine-like substance. Concerning the presence of histamine in the blood there is considerable controversy in the literature. Hanke and Koessler,[10] Guttentag,[11] Zipf and Hülmeyer [12] and MacGregor and Peat [7a] reported negative findings. Gebauer-Fuelnegg and Dragstedt [13] in their study of the nature of the physiologically active substance appearing during anaphylactic shock showed that the dialysate of thoracic lymph and of blood from the inferior vena cava during shock contain histamine and that the dialysate of normal lymph does not have any depressor activity similar to that of histamine. Later Dragstedt and Mead [14] showed that in anaphylactic shock of moderate severity, samples of blood taken one, two or three minutes after the shocking dose of serum are usually active, although later samples may give negative results. They found also that intravenously injected histamine is inactivated as rapidly as histamine pro-

3. Barger, G., and Dale, H. H.: B Iminozolyl Ethylamine a Depressor Constituent of Intestinal Mucosa, J. Physiol. **41**:499, 1911.

4. Dale, H. H., and Dudley, H. W.: The Presence of Histamine and Acetylcholine in the Spleen of the Ox and Horse, J. Physiol. **68**:97, 1929.

5. (*a*) Best, C. H.; Dale, H. H.; Dudley, H. W., and Thorpe, W. V.: The Nature of the Vaso-Dilator Constituents of Certain Tissue Extracts, J. Physiol. **62**:397, 1927. (*b*) MacGregor, R. G., and Thorpe, W. V.: The Quantitative Extraction of Histamine from Tissues by Electrodialysis, Biochem. J. **27**:1394, 1933.

6. Gavin, G.; McHenry, E. W., and Wilson, M. J.: Histamine in Canine Gastric Tissues, J. Physiol. **79**:234, 1933.

7. (*a*) MacGregor, R. G., and Peat, S.: An Investigation into a Possible Nervous Mechanism Involved in the Liberation of Histamine, J. Physiol. **71**: 31, 1931. (*b*) MacGregor and Thorpe.[5b]

8. Best, C. H.: The Disappearance of Histamine from Autolyzing Lung Tissue, J. Physiol. **67**:256, 1929.

9. Harris, K. E.: Observation upon a Histamine-Like Substance in Skin Extracts, Heart **14**:161, 1927.

10. Hanke, M. T., and Koessler, K. K.: Studies on Proteinogenous Amines: XX. On the Presence of Histamine in Mammalian Organism, J. Biol. Chem. **59**: 889, 1924-1925.

11. Guttentag, O. E.: Histamin und histaminartige Substanzen im Blut, Arch. f. exper. Path. u. Pharmakol. **162**:727, 1931.

12. Zipf, K., and Hülmeyer, P.: Histamineähnliche Stoffe und Spätgift im Blut, Arch. f. exper. Path. u. Pharmakol. **173**:1, 1933.

13. Gebauer-Fuelnegg, E., and Dragstedt, C. A.: Studies in Anaphylaxis: I. The Appearance of a Physiologically Active Substance During Anaphylactic Shock, Am. J. Physiol. **102**:512, 1932.

14. Dragstedt, C. A., and Mead, F. B.: Inactivation of Histamine in Vivo, Proc. Soc. Exper. Biol. & Med. **32**:1435, 1935.

duced in the anaphylactic animal. It is known that many times the lethal dose of histamine can be injected into animals if the injections are made slowly. The phenomenon was explained by Best and McHenry [15] when they found in the body an enzyme, histaminase, which is specific for the destruction of histamine.

Barsoum and Gaddum [16] in their investigation on the pharmacologic estimation of adenosine and histamine in the normal blood of mammals reported the following values, expressed as histamine equivalent per cubic centimeter of blood.

Rabbit	9.6 to 12.0
Guinea-pig	1.0 to 1.5
Dog	0.04 to 0.075
Man	0.03 to 0.04
Cat	0.013

These values, they stated, arrange the animals roughly in order of their sensitivity to histamine. Rabbits under anesthesia are insensitive to histamine, whereas cats are extremely sensitive. Anrep and Barsoum [17] reported that 15 per cent of the histamine content of 1 cc. of blood is in the plasma and about 85 per cent in the red blood corpuscles.

Harkins and Harmon [18] studied the depressor activity of human tissues, normal and toxic thyroid, carcinomatous tissue and muscle and concluded that the major part of the depressor substance present in the tissue extracts does not act like acetylcholine or histamine when tested for effect on the blood pressure of the atropinized rabbit.

METHODS

Nasal polypi were collected at the time of operation, weighed and immediately placed in an extractive medium to prevent the destruction of histamine by the enzyme histaminase. Extracts were made by the method of Hanke and Koessler,[19] Sacks, Ivy, Burgess and Vandolah [20] or Best and McHenry.[15] The last method proved the most useful for the small amount of material available. The biologic assay of histamine was made on the anesthetized, atropinized male cat. The extracts were made to a volume at which 1 cc. was equivalent to 0.5 Gm. of moist

15. Best, C. H., and McHenry, E. W.: The Inactivation of Histamine, J. Physiol. **70**:349, 1930.

16. Barsoum, G. S., and Gaddum, J. H.: The Pharmacological Estimation of Adenosine and Histamine in Blood, J. Physiol. **85**:1, 1935.

17. Anrep, G. V., and Barsoum, G. S.: Distribution of Histamine Between Plasma and Red Blood Corpuscles, J. Physiol. **85**:36, 1935.

18. Harkins, H. N., and Harmon, P. H.: Depressor Extracts of Some Human Tissues, Proc. Soc. Exper. Biol. & Med. **32**:23, 1934.

19. Hanke, M. T., and Koessler, K. K.: Studies on Proteinogenous Amines: VIII. A Method for the Quantitative Colorimetric Estimation of Histamine in Protein and Protein Containing Matter, J. Biol. Chem. **43**:543, 1920.

20. Sacks, J.; Ivy, A. C.; Burgess, J. P., and Vandolah, J. E.: Histamine as the Hormone for Gastric Secretion, Am. J. Physiol. **101**:331, 1932.

tissue. Injections were made intravenously into the femoral vein; blood pressure was measured from the carotid artery. The respiration, the interval of injection and the time were also recorded on the kymograph. The time of injection was twelve seconds. Standard solutions of histamine acid phosphate (p_H 7.4) were used on each cat for comparison with the unknowns. The technic was kept uniform in all experiments so as to get comparable and consistent results. Like Page,[21] we found that female cats give erratic results.

For comparison, the mucous membrane from the middle turbinate was removed at autopsy. The specimens were secured within four hours after death, and treated in a manner identical to that of the polypi. Specimens of normal and polypoid tissue were sent through for paraffin sectioning for pathologic study.

Nasal secretion from persons suffering from allergic rhinitis was collected directly into extractive medium by the patient.

The Pauly reaction, described by Koessler and Hanke,[22] was employed to detect the presence of histamine. Zimmermann's [23] specific test (cobalt nitrate) for histamine was found to be less delicate than Koessler and Hanke's quantitative procedure.

In the early experiments an anticoagulant, Chicago blue,[23a] was used, but its use was discontinued because the results appeared more consistent when it was omitted. The data reported do not include records made when the anticoagulant was injected.

RESULTS

The extracts from nasal polypi (Best and McHenry) always produced a fall in blood pressure. This fall, expressed as histamine equivalent (table 2), shows that polypoid tissue contains from 3.6 to 10.2 mg. of histamine-like substance per kilogram of moist tissue. Normal mucous membrane also gave the characteristic depressor activity of histamine in almost identical amounts (table 1). However, for comparable quantities the results must be calculated on the basis of the dry weight of the tissue. Mittermaier [24] reported that polypi have an average content of solid material of 13.78 per cent, and Russel and Gies [25] have found that mucous membrane taken at random from the nose contains 21.5 per cent of organic matter. Using these average values to compute the amount of histamine-like substance in 1 Gm. of dry tissue,

21. Page, I.: Pressor Substances from Body Fluids of Man in Health and Disease, J. Exper. Med. **61**:67, 1935.

22. Koessler, K. K., and Hanke, M. T.: Studies on Proteinogenous Amines: II. A Microchemical Colorimentric Method for Estimating Imidazole Derivatives, J. Biol. Chem. **39**:497, 1919.

23. Zimmermann, W.: Specific Color Reaction for Histamine, Ztschr. f. physiol. Chem. **186**:260, 1930.

23a. Chicago blue is tetrazotized di-anisidine doubly coupled in alkaline solution with 1-amino-8-naphthol-2: 4-disulfonic acid.

24. Mittermaier, R.: Der Mineralstoffwechsel bei entzündlichen Nasen und Nebenhöhlenerkrankungen: Flussigkeitsgehalt und Gesamt Mineralbestand, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **134**:147, 1933.

25. Russel, B., and Gies, W. J.: The Chemical Composition of the Nasal Mucous Membrane, Science **23**:336, 1906.

a variation appears, showing that polypoid tissue contains more histamine than the normal mucous membrane. On the basis of dry weight the polypi contain between 43.5 and 148 mg. per gram of tissue, and normal mucous membrane contains from 35.7 to 85 mg. per gram. How much the lapse of time (from three to four hours) after death

TABLE 1.—*The Histamine Content of Normal Nasal Mucous Membrane*

Patient	Age	Clinical Diagnosis	Pathologic Changes	Histamine Equivalent, Mg. per Kg. of Tissue
J. W.	77	Bronchopneumonia; cardiac asthma	.....	5.4
V. H.	39	Tuberculosis	Epithelium nonciliated, squamous type; no cell infiltration	3.3
K. H.	44	Hyperthyroidism	.....	4.1
M. D.	58	Osteomyelitis of skull; subtotal thyroidectomy	Normal nasal mucous membrane	4.6
T. M.	22	Seasonal hay fever; epilepsy due to cerebral neoplasm	Round cell and eosinophilic infiltration; epithelium flattened	2.4
M. W.	60	Carcinoma of uterus (cervix)	Normal nasal mucosa	9.2

TABLE 2.—*The Histamine Content of Nasal Polypi*

Patient	Age	Clinical Diagnosis	Pathologic Changes	Histamine Equivalent, Mg. per Kg. of Tissue
F. B.	18	Polypi; right maxillary sinusitis	Subepithelial stroma shows round cell, neutrophilic and small amount of eosinophilic infiltration	3.6
C. S.	46	Polypi and rhinorrhea	Polyp showed edematous connective tissue; stroma infiltrated with large numbers of eosinophils	4.6
Composite Sample				
J. M.	84	Nasal obstruction, 15 years	Edematous stroma infiltrated with round cells and a few eosinophils	10.2
C. M.	59	Polypi, obstruction 4 years	Stroma edematous; shows only few eosinophils	...
E. S.	23	Polypi and headache		
P. P.	..	Polypi	.....	5.4
A. L.	49	Polypi; sinusitis	.....	3.5
L. G.	45	Nasal obstruction for years; purulent discharge	Stroma infiltrated with numerous round cells and eosinophils	4.4
W. V.	22	Nasal obstruction, 3 years	Marked round cell infiltration; only a few scattered eosinophils	8.4
E. S.	31	Polypi and hay fever	Stroma shows only few eosinophils	10.2
W. W.	40	Maxillary sinusitis; polypi	Round cell infiltration; only few scattered eosinophils	6.4

enters into the results was not determined. Contradictory statements regarding the stability of histamine in the tissue are recorded in the literature. MacGregor and Peat [7a] found no difference in the histamine content in minced lung which stood over night.

Figures 1 and 2 show the effect of extracts of nasal tissue on the blood pressure of the cat.

Most of the depressor activity of our substance must be due to histamine. The administration of atropine eliminates the depressor activity of choline, acetylcholine and other choline esters. The method of preparation, hydrolysis at 95 C. in 10 per cent hydrochloric acid for an hour, destroys the "depressor substance P" of Gaddum and Schild.[26] The extract did not depress the blood pressure of the atropinized, anesthetized rabbit; consequently the adenosine compounds could not be responsible for the depressor activity. Histidine injected intravenously in amounts equivalent to the maximum quantities present in hydrolyzed tissue was without effect on the blood pressure. This finding is in accord with the work of Barger and Dale,[27] in which they reported that pure histidine is inactive. Abel and Kubota [28] also reported that histidine has no effect on the blood pressure. A commercial preparation of histidine di-hydrochloride, chemically pure, injected in 5, 10 and 20 mg. portions produced an increasing fall in the blood pressure of the

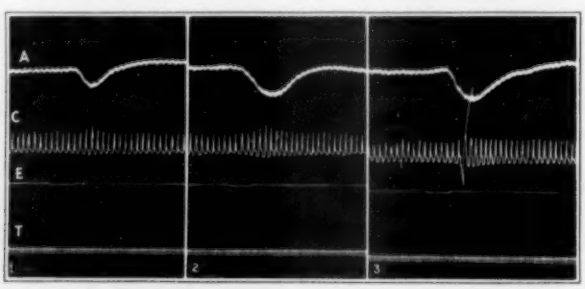

Fig. 1.—In both figure 1 and figure 2, *A* indicates the blood pressure in the carotid artery of a cat under anesthesia with sodium amytal; *C*, the respiration; *E*, the interval of injection, and *T*, the time in seconds.

Tracing *1* shows the effect of extract of the normal mucous membrane; *2*, that of nasal polypi, and *3*, that of a solution of histamine acid phosphate equivalent to 0.0038 mg. of histamine base. The extracts injected were equivalent to 0.5 Gm. of moist tissue. Injections were made intravenously.

atropinized anesthetized cat with the increase in quantity administered. If histamine were present in the histidine 1 part in 5,000, similar depressor activity would be obtained. It was thus found that commercially prepared histidine contains histamine as a contaminant in quantities great enough for biologic assay. Physiologic solutions of

26. Gaddum, J. H., and Schild, H.: Depressor Substances in Extracts of Intestine, J. Physiol. **83**:1, 1934.

27. Barger, G., and Dale, H. H.: 4 β Amino Ethyl Glyoxaline (β Iminazolyl Ethylamine) and Other Active Principles of Ergot, J. Chem. Soc. **97**:2592, 1910.

28. Abel, J. J., and Kubota, S.: On the Presence of Histamine (β Iminazolyl Ethylamine) in the Hypophysis Cerebri and Other Tissues of the Body and Its Occurrence Among Hydrolytic Decomposition Products of Proteins, J. Pharmacol. & Exper. Therap. **13**:243, 1919.

sodium chloride and solutions of the concentration of the unknown injected intravenously had no effect on the blood pressure. The solutions of sodium chloride were made by neutralizing 10 per cent hydrochloric acid to litmus with a 10 per cent solution of sodium hydroxide. But not all the depressor activity can be attributed to histamine, as the decolorized extracts always gave a positive biuret reaction. It is probable that the hydrolytic products enhance the effect of histamine. Hanke and Koessler [29] showed that peptone from fibrin, free from histamine, causes vasodilatation. MacGregor and Thorpe reported an increased histamine equivalent in their experiments when the parchment membrane passed biuret products. These authors also stated that the method of Best and McHenry [15] gave them a 30 per cent higher yield.

The extract from Witte's peptone (Best and McHenry [15]) injected intravenously produced a much greater fall in blood pressure than a similar solution previous to hydrolysis. This phenomenon might be

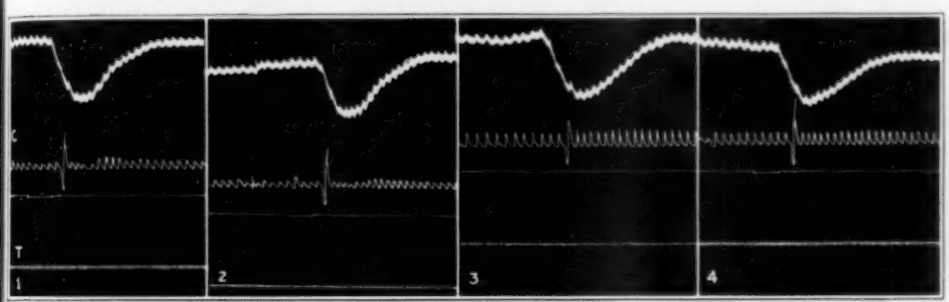

Fig. 2.—Tracing *1* shows the effect of extract of normal nasal mucous membrane; *2*, that of extract V from nasal polypi; *3*, that of extract S from nasal polypi, and *4*, that of the solution of histamine acid phosphate equivalent to 0.0038 Gm. of the base. The extracts injected were equivalent to 0.5 Gm. of moist tissue.

due to one of two factors or to the influence of both. The products of the hydrolysis of peptone may be more potent than the peptone itself, or there may be better utilization of the histamine present, as after hydrolysis there is no colloid to adsorb the histamine. Witte's peptone and other commercial brands of peptone have been shown to contain histamine or substances which have the pharmacologic action of histamine (Hanke and Koessler,[29] Nasset and Pierce [30]). Although the

29. Hanke, M. T., and Koessler, K. K.: Studies on Proteinogenous Amines: X. The Relation of Histamine to Peptone Shock, J. Biol. Chem. **43**:567, 1920.

30. Nasset, E. S., and Pierce, H. B.: On the Influence of Peptones and Certain Extracts of Small Intestines upon the Secretion of Succus Entericus, Am. J. Physiol. **113**:568, 1935.

effect of peptone has not been ruled out, not all the depressor activity could be due to the small amount of peptone in the extract. The extract of nasal secretions, representing from 0.09 to 0.33 Gm. of mucin caused a fall in blood pressure. This fall, however, is much smaller than that produced by 0.5 Gm. of polypi equivalent to 0.06 Gm. of protein. Histamine is probably absent, the small amount of depressor activity being due to the proteoses formed during hydrolysis. Nasal secretions prepared by the method of Hanke and Koessler and by that of Sacks and his associates always gave negative results. Polypi extracted by the procedure of Hanke and Koessler did not show any evidence of the presence of a histamine-like substance. The Pauly reaction of these extracts was likewise negative. The negative findings may be attributed to the small amount of the specimens available. When known quantities of histamine acid phosphate, equivalent to 1.8 mg. of histamine base, were treated in a similar manner, much of the depressor activity was lost, but when an equal quantity of histamine was added to polypi and worked up in exactly the same manner, a much greater activity was obtained, though even then the amount was not equivalent to the amount added. It is possible that the tissue played only a protective rôle, but it is equally possible, in the light of the work of others, that an additional amount of histamine was present. Best, Dale, Dudley and Thorpe found that histamine itself added in known quantities to a sample was not extracted from alkaline solutions in a larger proportion than the natural depressor agent. It is hoped that these differences will be explained in future work.

Other observations were made with nasal secretion. A tenfold or twentyfold dilution, either filtered or unfiltered, does not show depressor activity in the anesthetized, atropinized cat. Nasal secretion does not contain histaminase, as was indicated by the results obtained when equal portions of nasal secretion were diluted with a physiologic solution of sodium chloride to which was added an equal amount of histamine, one kept at room temperature and the other previously boiled to destroy histaminase and both placed in an incubator for twenty-four hours. A control solution of histamine in a physiologic solution of sodium chloride was also incubated. There was no appreciable loss in the depressor activity of the three samples. It is concluded that nasal secretion does not contain histaminase.

Filtered and unfiltered nasal secretion were injected intradermally into a dog; the former produced a slight wheal, with erythema; the latter seemed to have no effect. The presence of protein in the unfiltered secretion might have had a buffering effect. Standard solutions of histamine of the concentration used intravenously did not cause the formation of wheals, nor did they give the characteristic red of the

Pauly reaction. A green tinge was produced, which was more intense as the histamine content increased. The nasal secretions of patients with allergic conditions are alkaline in many instances; this increases permeability, permitting serum albumin and the amino-acids to appear and to augment the allergic reaction. This may explain the greater sensitivity of the mucosal tests. It is known that the mucosa of the nose contains a rich venous plexus. Benjamins and his associates [31] reported that the cutaneous reactions obtained with whole pollen extract as well as with the ultrafiltrates are considerably intensified by the addition of serum albumin from human patients. The presence of albumin increases the potency of pollen extracts ten times. They also reported that the amino-acids, amino-acetic acid, cystine and leucine are possible activators.

COMMENT

In evaluating the rôle that histamine plays in the etiology of nasal polypi one must consider other factors. Stuart-Low [32] suggested that a dry, dirty, sandy atmosphere is also conducive to the formation of polypi. Investigators will have to look for a physicochemical explanation, such as the indexes of surface tension between dust and cells and between bacteria and cells. When chilling of the mucous membrane results in increased secretion, the salt content increases, which changes the reaction and favors the entrance of micro-organisms. With this increase in mineral content resulting in a decreased hydrogen ion concentration, decreased viscosity of the secretion and an increase in the permeability of the cells, the patient is certainly rendered more susceptible to secondary infection. Marked changes in difference of potential may be due to the increased output of potassium in the secretion. Berthier [33] has shown that the potassium content of living tissue is directly proportional to the biologic "potential" of the tissue. Blinks [34] has shown that potassium lowers the resistance of Nitella to penetration by other ions. Hemingway and McDowall [35] described experiments which illustrate that the maintenance of capillary tone as demonstrated by the response of these vessels to histamine is under the

31. Benjamins, C. E.; van Dishoeck, H. A. E., and German, J. L. M.: Studies on the Active Substance of Grass Pollen: I. Activation of a Small Molecular Weight Active Group Through Colloidal Substances, J. Allergy **6**:335, 1935.

32. Stuart-Low, W.: The Rôle of Mucous Membrane in Diseases of Nose, Throat and Ear, Lancet **1**:326, 1924.

33. Berthier, J.: Potassium humoral et potassium tissulaire, Compt. rend. Soc. de biol. **100**:894, 1929.

34. Blinks, L. R.: The Direct Current Resistance of Nitella, J. Gen. Physiol. **13**:495, 1930.

35. Hemingway, A., and McDowall, R. J. S.: The Chemical Regulation of Capillary Tone, J. Physiol. **62**:166, 1926.

control of a simple acid-base equilibrium. Histamine, they affirmed, is not able to show its dilator effects when the perfusing fluid becomes acid. Abramson [36] in his discussion on the migration of leukocytes stated that an electrical phenomenon is involved. The change in the hydrogen ion concentration certainly is one factor in leukocytic infiltration; the alkaline secretion might aid in calling forth the eosinophils, and the acid secretion might have a greater tendency to cause polymorphonuclear leukocytes to infiltrate the tissue (Wenner and Nemours,[37] Menkin and Warner [38]). The former condition is usually present in allergic disturbance and the latter in sinusitis. Höber [39] in discussing the colloidal structure of plasma membrane said that a change in the ion content of the surrounding medium is often accompanied by alteration of the normal permeability of the cells. Disturbances in the physiologic relations between univalent and divalent cations are often followed by the anomalous entrance or exit of substances through the superficial layer of the protoplasts. He continued that many reasons support the well known opinion of Loeb that these influences are due to changes in the colloidal state of the plasma membrane. Any change in the colloid of the cell or in its content of electrolytic substances changes its reactivity (Pottenger).[40] The mineral content of the secretion in nasal disease has been shown by one of us [41] to differ markedly from that of the blood. Duke [42] wrote that a person who had an infectious disease will respond more quickly to the effects of a parenterally introduced protein than will a normal person and at the same time is more readily sensitized to that protein than a normal person. In other words, it may be assumed that an infectious disease increases

36. Abramson, H. A.: The Electrical Charge of the Blood Cells of the Horse and Its Relation to the Inflammatory Process, in Symposia on Quantitative Biology, New Bedford, Mass., Darwin Press, 1933, vol. 1, p. 92.

37. Wenner, W. F., and Nemours, P. R.: The Mucosa of the Maxillary Sinus of the Rabbit: Effect of Acidosis and Alkalosis on Changes in Ciliated Epithelium and Eosinophilic Infiltration Produced by Calcium Precipitating Substances, Arch. Otolaryng. **15**:270 (Feb.) 1932.

38. Menkin, V., and Warner, Charlotte: Significance of Carbohydrate Metabolism and Local Acidosis in Inflammation, Proc. Soc. Exper. Biol. & Med. **34**: 594, 1936.

39. Höber, R.: Permeability, in Luck, J. M.: Annual Review of Biochemistry, Stanford University, Calif., Stanford University Press, 1932, vol. 1, p. 1.

40. Pottenger, F. M.: A Discussion of the Etiology of Asthma in Its Relationship to the Various Systems Composing the Pulmonary Neuro-Cellular Mechanism with the Physiologic Basis for the Employment of Calcium in Its Treatment, Am. J. M. Sc. **167**:203, 1924.

41. Buhrmester, C. C.: The Chemical Composition of Secretions from Allergic Rhinitis and Sinus Exudates, Laryngoscope **45**:347, 1935.

42. Duke, W. W.: Allergy as Related to Otolaryngology, Arch. Otolaryng. **22**:638 (Nov.) 1935.

susceptibility to sensitization to foreign matter. Persons with an infection undoubtedly have a disturbed chemicophysical equilibrium. A good nutritional program, with the patient in optimum physicochemical balance, is one of the best aids in the prevention of difficulties. Major [43] has found that in sensitized rabbit blood the nonprotein nitrogen, urea and creatinine content are increased in anaphylactic shock and that the amount of chlorine is decreased. These changes, he found, are more marked when the animal is on a deficiency diet. Thus, any slight disturbance in the physicochemical equilibrium results in changes in function and structure of the tissue. Alteration in the amount of histamine present in the tissue is probably directly proportional to the degree of injury to the cells.

SUMMARY

Nasal polypi and normal mucous membrane are shown to contain a histamine-like substance in approximately equal amounts in the moist tissue. Calculated on the basis of the dry weight of the tissue, polypoid tissue contains more histamine than the normal membrane.

Nasal secretion from persons with allergic rhinitis does not have depressor activity when injected intravenously. The hydrolyzed secretion contains much less histamine-like substance than do polypi, calculated on equal protein values.

Histaminase is not present in allergic nasal secretions.

It is suggested that the increase in mineral content of the nasal discharge, with its resulting effect on permeability, difference in potential and acid-base equilibrium, are factors to be considered in studying the formation of polypi and other allergic manifestations.

Dr. W. S. Rose, of the University of Illinois, supplied us with histidine from his laboratories.

43. Major, R. H.: Studies of Blood Chemistry in Allergy, Bull. Johns Hopkins Hosp. **34**:104, 1923.

POSTOPERATIVE REGENERATION OF THE MUCOUS MEMBRANE OF THE PARANASAL SINUSES

A SUMMARY OF THE PUBLISHED INVESTIGATIONS

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The practical importance of the regeneration of the mucous membrane of the paranasal sinuses, aside from its interest from an academic point of view, is real and readily apparent. The local results of an operation which removes the mucous membrane of the paranasal sinuses should be of great interest to the otolaryngologist. If investigation shows that following radical surgical intervention on a sinus the mucous membrane regenerates in a more or less normal form, there is further justification for adequate surgical intervention.

What apparently has been until recently the prevailing opinion concerning postoperative regeneration of the mucous membrane of the paranasal sinuses was expressed by Carter [1] in 1930, when he wrote: "Bare bone does not procure for itself another periosteum, nor does it remain alive. Ciliated epithelium once destroyed is never regenerated. Normal mucous glands do not reappear in the scar tissue which follows the destruction of mucous membrane, nor is this scar tissue capable of performing any physiologic function."

McGregor [2] called attention to the self-evident but easily forgotten fact that the ciliated epithelium of the paranasal sinuses is continuous with the squamous epithelium of the outer surface of the body. He referred to Adami in stating that the epitheliums of the body stand preeminent in their capacity for complete regeneration. Mosher [3] stated: "If you take the trouble to look up the subject you will find that epithelium makes every effort to reform." All cells have an inherent tendency to multiply. Nowhere in the body will nature tolerate a surface denuded of epithelium, whether it be skin or mucous membrane. McGregor quoted Fisher, who found that cultures of epithelial tissue double their size in from three to four days. Balbioni and Hennequy

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1. Carter, W. W.: A Plea for More Conservatism in the Treatment of Nasal Accessory Sinus Infections, Ann. Otol., Rhin. & Laryng. **39**:578-583 (June) 1930.

2. McGregor, Gregor: Further Proof of the Regeneration of Mucous Membrane of the Human Antrum, Arch. Otolaryng. **14**:309-326 (Sept.) 1931.

3. Mosher, Harris P.: Summary of Symposium (on Nasal Mucous Membrane), Tr. Am. Acad. Ophth. **37**:440-446, 1932.

showed that the ends of the tails of two tadpoles placed in contact after scarification grow together in an hour and a half by means of the superficial growth of the epithelium. When fistulous tracts lead into bone, the epithelium, owing to its property of spreading, may grow into the fistula and even line the cavity in the bone. Large pulmonary cavities may become lined with epithelium. Heape found that the uterus of the monkey is relined with epithelium about seven days after menstruation and about fourteen days after the termination of pregnancy. Regeneration of the epithelium of the stomach is interfered with by constant muscular activity and irritation from food and gastric juices. Still, Ferguson demonstrated that the gastric mucosa regenerates at the rate of 2 mm. a week over areas from which 25 sq. cm. has been excised. In this tissue even the specialized gland cells regenerate. In the face of these facts it would seem strange if the mucous membrane of the paranasal sinuses did not regenerate after its radical removal. Proetz [4] has written that not only are the cilia of the mucous membrane of the paranasal sinuses less delicate than is often thought but there is no doubt that they can and frequently do regenerate with the regenerated membrane after the radical exenteration of a sinus.

For most of the reported experimental work on this question the dog has been used. Coates and Ersner [5] studied the regeneration of the epithelium of the frontal sinuses of a dog. They operated radically on both frontal sinuses and regarded the specimen obtained by the first operation as normal and the standard of comparison. They were surprised to find neither goblet cells nor glands. Two months later they removed the regenerated tissue from the right frontal sinus only. In the last operation both sinuses were exenterated: the right seven months after the second operation and the left nine months after the first operation. Glandular structures appeared in the regenerated lining, which showed inflammatory reaction as well. They obtained definite epithelial regeneration but could not consider it entirely normal.

Knowlton and McGregor [6] reported their first work on the question in 1928. They carried out their experiments on three large dogs. The maxillary sinuses were operated on through the usual approach. Autopsy was performed one, three and five months, respectively, after operation. They found that one month after the lining of the antrum

4. Proetz, A. W.: Motion Picture Demonstration of Ciliary Action and Other Factors of Nasal Physiology, Tr. Am. Laryng. A. **54**:264-273, 1932.

5. Coates, George Morrison, and Ersner, Matthew S.: Regeneration of the Mucous Membrane of the Frontal Sinus After Its Surgical Removal (in the Dog), Arch. Otolaryng. **12**:642 (Nov.) 1930.

6. Knowlton, C. D., and McGregor, G. W.: How and When the Mucous Membrane of the Maxillary Sinus Regenerates, Arch. Otolaryng. **8**:647 (Dec.) 1928.

is removed epithelial regeneration is well established. It is complete by the end of three months. Five months after operation regeneration of the glands is well established and the mucoperiosteum looks almost normal.

Hilding [7] reported pertinent experimental work on the frontal sinus of the dog. In some animals narrow strips of mucous membrane from the frontal sinus were removed, and in others the septum between the sinuses was removed submucously. The results were observed over periods ranging from one day to thirty-six weeks. He found that ridges and diaphragms interfere with normal drainage and cause mucin to collect in pools if the obstruction is so placed that the mucin cannot slide around it. When he removed a complete ring of mucous membrane from the inside of the sinus in any plane, the circular scar that formed in healing became a complete diaphragm of connective tissue, dividing the sinus into two cavities. He found that a septum between sinuses can be removed and that the resulting opening will remain patent if the edges of the mucous membrane on the two sides of the partition are made to meet.

The mucous membrane of the frontal sinuses of another series of eight dogs was entirely removed. In a third series large portions of the mucous membrane of four sinuses of four dogs were removed, but some islands were left intact. Observations were carried out over periods varying from a few weeks to over a year. Each dog was observed by surgical exploration from two to eight times. Hilding found that after complete denudation of the frontal sinus of the dog, the sinus usually tends to heal by massive scar formation that obliterates the cavity. In one instance the cavity became lined by epithelium. In some cases he found cysts filled with mucin embedded in the scar tissue, and he expressed the opinion that the cysts were formed from epithelium that was left behind at the time of operation.

One of the earliest reports of a single case of regeneration of sinus epithelium was published by Tonndorf [8] in 1928. His patient died of an abscess of the liver a month after a radical operation on the antrum, at which time the membrane of the sinus was removed.

7. Hilding, A.: Four Physiologic Defences of Upper Part of Respiratory Tract: Ciliary Action, Exchange of Mucin, Regeneration and Adaptability, Ann. Int. Med. **6**:227-234 (Aug.) 1932; Experimental Surgery of Nose and Sinuses: Gross Results Following Removal of Intersinus Septum and of Strips of Mucous Membrane from the Frontal Sinus of Dog, Arch. Otolaryng. **17**:321-327 (March) 1933; Experimental Surgery of Nose and Sinuses: Results Following Partial and Complete Removal of Lining Mucous Membrane from Frontal Sinus of Dog, ibid. **17**:760-768 (June) 1933.

8. Tonndorf: The Regeneration of the Antral Lining After a Caldwell-Luc Operation, Ztschr. f. Hals-, Nasen- u. Ohrenh. **22**:54 (June) 1928.

Granulation tissue arising from the endosteum covered all the antrum, and ciliated columnar epithelium was growing in from the naso-antral opening. The advancing border of the mucous membrane was flat and nonciliated.

The remainder of the foreign literature on the subject has been contributed by Ssamoylenko,[9] Boenninghaus[10] and Lange.[11] These authors experimented largely with the frontal sinus in various animals and reported some observations concerning surgical intervention in the frontal sinus of man. In every case they attempted to obliterate the sinus without obtaining a cosmetically bad result. In most instances they succeeded. They could not expect to observe reformation of a mucous membrane lining when they succeeded in obliterating the sinus cavity.

Latta and Schall[12] presented studies of the epithelium of the paranasal sinuses under varying conditions. They studied the lining of the antrum from a person who had had a complete resection of the membrane twenty-four days before. They found rapid regeneration of both the epithelium and the underlying connective tissue. The epithelial cells did not entirely cover the connective tissue and were of the low columnar type. These were regarded by Latta and Schall as undifferentiated basal cells capable of forming either ciliated or goblet cells.

Semenov and Kistner[13] removed a small part of the lining of the antrum from an adult, and after four months they observed normal regeneration. When they removed a larger area they found after a period of two years a dense mass of scar tissue covered by an indifferent layer of cuboidal epithelium. The usual histologic structure was absent. When they removed all the lining, they obtained regeneration and a lining of stratified columnar epithelium if a tongue of nasal mucosa was placed on the floor of the antrum. Interestingly, they obtained a lining of stratified squamous epithelium when communication with the buccal cavity was maintained.

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9. Ssamoylenko, M. A.: Postoperative Verödung der Stirnhöhlen, Arch. f. Laryng. u. Rhin. **27**:137-154, 1913; Virchows Arch. f. path. Anat. **211**:176, 1913.

10. Boenninghaus, in Katz, L.; Preysing, H., and Blumenfeld, F.: Handbuch der speziellen Chirurgie des Ohres und der oberen Luftwege, Würzburg, C. Kabisch, 1911, vol. 3, p. 104.

11. Lange: Beitr. z. Anat. d. Ohres **4**:1, 1911; **13**:1-13, 1919; **17**:1, 1921.

12. Latta, J. S., and Schall, R. F.: The Histology of the Epithelium of the Paranasal Sinuses Under Various Conditions, Ann. Otol., Rhin. & Laryng. **43**: 945-971 (Dec.) 1934.

13. Semenov, H., and Kistner, F. B.: Repair in the Paranasal Sinuses of Man Following Removal of the Mucous Membrane Lining, Proc. Soc. Exper. Biol. & Med. **27**:322, 1930.

Semenov [14] stated that there is always formation of scar tissue in the regenerated mucous membrane, that the healing varies from place to place and that the postoperative membrane is a poor substitute for the original normal membrane but doubtless better than a pathologic membrane full of polyps, cysts and abscesses.

Goodyear [15] found after many Caldwell-Luc operations that the cavity of the antrum became filled with thick fibrous tissue and that in some cases pocketing and reinfection occurred. He stated that the present teaching is that the scar tissue which forms in the sinus after a radical surgical procedure becomes covered by ciliated columnar epithelium.

Lewis [16] spoke of the dissimilarity between experimental results and those obtained by radical operation on human beings. He spoke of the frequent occurrence of "cicatricial basement membrane, squamous and cuboidal epithelium, vestiges of glands, general fibrotic changes and more or less complete obliteration of the stomata and subepithelial lacunae." In discussing Lewis' paper, Fenton said: "If the lateral wall of the nose be not too greatly disturbed by radical external surgery of the maxillary antrum, normal ciliated mucosa may be again established by outgrowth from the nasal epithelium of the ostia and artificial openings."

McGregor [2] studied twenty-four antrums and two frontal sinuses after radical operation. All twenty-six specimens were ciliated except one. In all cases a radical operation had been done and the membrane had been removed as completely as possible by subperiosteal exenteration, or decortication, as St. Clair Thompson called it. The length of time after operation ranged from sixteen days to nine years. The sixteen day specimen consisted of a great number of young capillaries supported by newly formed connective tissue in which there were many fibroblasts. Lymphocytes were scattered throughout. On the surface was regenerated epithelium, the cells of which were loosely placed and stood in a palisade arrangement, without cilia. A six month old specimen from a frontal sinus showed a continuous layer of ciliated epithelium. The stroma was still thick and edematous. A two year old specimen from the antrum showed a three-layered ciliated epithelium resting on a thin basement membrane and containing many distended goblet cells.

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14. Semenov, Herman: The Surgical Pathology of Sinusitis, Tr. Pacific Coast Oto-Ophth. Soc. **22**:125-153, 1934.

15. Goodyear, H. M.: Chronic Antrum Infection: Treatment by Intranasal Antrum Operation and Packing; Clinical and Experimental Results, Arch. Otolaryng. **20**:542-548 (Oct.) 1934.

16. Lewis, E. R.: Considerations for and Against Curetting and Exenterating Sinus Operations, Tr. Am. Laryng., Rhin. & Otol. Soc. **35**:190-196, 1929.

Gorham and Backer [17] studied the question in material obtained from human patients by surgical operation. The Caldwell-Luc operation was modified in that the naso-antral wall of the middle meatus was removed as well as the wall of the inferior meatus. A flap of nasal mucosa was cut and turned down on the floor of the antrum. An arc of the free edge of the inferior turbinate was removed just posterior to its anterior end, directly opposite the opening in the inferior meatus. The patients were examined at intervals varying from two weeks to ten months. A nasopharyngoscope was passed through the naso-antral window, and specimens of the membrane for biopsy were removed with straight ear forceps with biting jaws. These were taken from the posterolateral wall distant from the flap of nasal mucosa originally turned into the sinus and from a point known to have been denuded of membrane at operation. They found that two weeks after operation the lining of the sinus is red and uneven. At one month the lining is more pale and more smooth, and small glistening areas can be seen in the region of the nasal flap on the floor and also on the posterior wall close to the opening in the middle meatus. In from three to five months the lining becomes relatively smooth, glistening and pale pink, with delicate capillaries visible.

Microscopically, there is a small basal layer of fibrous tissue, with occasional outgrowth of new connective tissue into the mass of red cells overlying it at the end of two weeks. The free margin shows some round cells and a thin layer of fibrin. Angioblasts and fibroblasts spread rapidly through the mass of red blood cells, and the picture in three weeks becomes that of an organized clot. By the end of four weeks the organization of the tissue changes to a membrane consisting largely of young connective tissue cells, except for occasional areas of continued organization. The numerous small capillaries give way to small, walled vessels. Within four weeks, epithelization has progressed so that there is a loosely formed ciliated columnar epithelium, which becomes flat and loses its cilia at the border. Regeneration begins within four weeks. At the end of two months the membrane is thinner and the connective tissue is of more adult character. The flattened nonciliated epithelium has almost entirely given way to pseudostratified ciliated columnar epithelium. At the end of four months the epithelium is practically reformed. A definite basal membrane is present, and the entire structure rests on a basal layer of dense fibrous tissue. At the end of ten months the membrane is perfectly formed.

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17. Gorham, C. B., and Backer, J. A.: Regeneration of the Human Maxillary Antral Lining, Arch. Otolaryng. **11**:763-777 (June) 1930.

Kistner [18] reported observations based on tissues from seven patients on whom a complete operation was performed after a previous Caldwell-Luc operation, six biopsy specimens being obtained from antrums through the counter opening, one from an antrum through a large permanent opening in the canine fossa and one from a healed ethmoid sinus. The nasal mucous membrane plays an important part in determining the character of the postoperative epithelium, for it is frequently its source. He observed that the spread of nasal epithelium is inconstant and unreliable, the character of the cells changing from stratified ciliated columnar to low cuboidal. He again pointed out that the antrum may come to be lined by stratified squamous epithelium if an oral fistula persists. In every case the membrane rests on new-formed bone, a thick layer of scar tissue and a thick submucosa.

McGregor [19] visualized the method of repair somewhat as follows: In radical removal of the epithelium some connective tissue is probably left. This proliferates rapidly, coming to line the cavity. Epithelium readily grows in from the nasal cavity. The borders of the ingrowing epithelial cells become flattened and lose their cilia, but the cells regain these characteristics of maturity when the defect of the surface is bridged. The anlagen of glands are again formed by ingrowth of surface epithelial elements.

From the macroscopic and microscopic observations described, one is drawn to the inevitable conclusion that complete regeneration of the lining of the paranasal sinuses, including ciliated columnar epithelium, is the rule after the operative removal of the original membrane. The time required for complete regeneration of the epithelium is apparently between three and five months. The type of cells composing the regenerated lining depends, in part at least, on its source, for while the epithelium is usually of stratified ciliated columnar type and comes from the nasal mucosa, it may be of stratified squamous type and come from the buccal mucosa.

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18. Kistner, F. B.: Ann. Otol., Rhin. & Laryng. **39**:977, 1929; Histopathology and Bacteriology of Sinusitis, with Comments on Postoperative Repair, Arch. Otolaryng. **13**:225-237 (Feb.) 1931.

19. McGregor, Gregor: Reformation of Mucous Membrane in Twenty Reoperative Cases of Chronic Maxillary Sinusitis, Tr. Am. Acad. Ophth. **37**:407-414, 1932.

LIGATION OF THE INTERNAL MAXILLARY ARTERY IN PATIENTS WITH NASAL HEMORRHAGE

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Hemorrhage from the posterior superior part of the nasal cavity is sometimes so severe that it ends fatally. It is especially severe in patients with high blood pressure and arterial hemorrhage from the posterior lateral nasal artery, which sometimes cannot be reached and ligated directly on the bleeding spot. Some cases have been reported in which the bleeding could be checked only by ligature of the external carotid artery or by ligation of the internal maxillary artery near its branching off from the external carotid artery. However, the retrograde circulation makes the result of such ligation uncertain because of the numerous anastomoses.

In 1929 Seiffert [1] worked out what he stated is the method of choice, after having repeatedly used it on living patients. In this procedure the maxillary sinus is opened from the oral cavity, just as in the Caldwell-Luc operation. Through a large opening of the posterior wall of the antrum the internal maxillary artery is separated by blunt dissection from the fatty tissue of the sphenomaxillary fossa. The vessel is then ligated with a suitable instrument. As in a radical operation on the antrum of Highmore, an opening is made into the nasal cavity at its inferior meatus to provide an outlet for possible secretion. Afterward the antrum is closed.

Seiffert claimed that this procedure can be used not only in instances of uncontrollable epistaxis but also in those of severe hemorrhage following nasal operation, prophylactically before operation on hyperemic tumor (hemangioma) and previous to the resection of the sphenopalatine ganglion through the maxillary sinus. The transmaxillary ligation of the internal maxillary artery is much easier for those surgeons who are accustomed to operate with the aid of artificial light in deep-seated cavities, and it has the advantage of not leaving any visible scars. My experience with the transmaxillary ligature of the internal maxillary artery according to the method of Seiffert has been so satis-

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1. Seiffert, Alfred: Unterbindung der Arteria maxillaris interna, Ztschr. f. Hals-, Nasen- u. Ohrenh. **22**:323, 1929.

factory that I believe that this method deserves to be more widely used. I have performed this operation in three cases.

REPORT OF CASES

CASE 1.—G. N., a man 65 years of age, over 6 feet (182.9 cm.) tall and weighing about 130 Kg., very plethoric and with a blood pressure of 210 (a typical Falstaff figure), had been bleeding from both sides of the nose for two days prior to examination. The family physician had first packed both sides of the nose with cotton wool, but the hemorrhage was not stopped, and a rhinologist was called in. After cocainization of the nose and generous use of epinephrine, the rhinologist stated that the source of the bleeding must be in the posterior part of the left side of the nose and did a galvanocauterization of the postsuperior and lateral area of the left side of the nose. However, the bleeding could not be controlled, and therefore postnasal and anterior packing with vioform gauze was done and intravenous injections of a solution of gelatin and a 10 per cent solution of calcium and dextrose were administered. Besides that, a subcutaneous injection of 1 cc. of solution of posterior pituitary was given but without success.

The patient was admitted to the hospital on March 3, 1931. He looked cyanotic; the pulse was thin and irregular, with a rate of 104, and the temperature was 38.3 C. (101 F.). Removal of the packing showed severe arterial bleeding from the postsuperior region of the nose, but in spite of extensive use of para-normo-butylaminobenzol-di-methylamino-ethanol hydrochloride and epinephrine the source of the hemorrhage could not be definitely located. Renewal of nasal packing with gauze treated with methylamino-aceto-ortho-di-oxybenzol did not yield the desired result. Because of the severe loss of blood, an intravenous injection of 1,000 cc. of a hypertonic solution of sodium chloride (1.8 per cent) was given. After local injection of a 1 per cent solution of procaine hydrochloride and epinephrine hydrochloride into the canine fossa and of 5 cc. of the same solution into the sphenomaxillary fossa (injecting at the middle of the superior edge of the zygomatic arch down to the tuber maxillare), the facial wall of the maxillary sinus was opened. The mucosa of the antrum was reddened and thickened, and there was some serous sanguinolent secretion in the cavity. The mucous membrane of the posterior wall of the antrum was separated, and the thin bone was opened with chisels and easily removed with a dull hooklet and a curved curet. In the fatty tissue of the sphenomaxillary fossa the internal maxillary artery and its branches were easily found by dull dissection. The main stem was remarkably large. The sphenopalatine artery was also well developed; the anterior alveolar artery as well as the descending palatine artery were rather small. Double ligature was carried around the internal maxillary artery near the sphenopalatine artery, with a small ligature carrier, and the vessel was severed with scissors. A large window was made into the inferior nasal wall. After removal of the nasal packing a cigaret drain was inserted from the inferior nasal meatus into the antrum. The oral mucosa was closed by catgut sutures. After the intervention the bleeding of the nose was completely stopped and no further packing was necessary. The patient received a blood transfusion of 600 cc., and during the next few days intravenous injections of 10 cc. of a 10 per cent solution of calcium gluconate were given three times a day. He made an uneventful recovery.

CASE 2.—M. C., 25 years of age, had the left ethmoid and sphenoid sinuses operated on in the office of a rhinologist. During the operation a severe hemorrhage from the inferior edge of the opening of the sphenoid cavity started and could not be controlled by the surgeon. Postnasal and anterior packing was done, and the patient was rushed to the hospital.

On admission (Oct. 18, 1931) he looked anemic and pale and had a very thin and irregular pulse, with a rate of 110. The temperature was 38.1 C. (100.8 F.). The packing was removed from the nose, and after generous use of para-normo-butylaminobenzol-di-methylamino-ethanol hydrochloride and epinephrine a pulsating hemorrhage at the inferior and lateral edge of the sphenoidal opening was seen but could not be controlled. An immediate intravenous injection of 600 cc. of a hypertonic (1.8 per cent) solution of sodium chloride was given, and the maxillary antrum was opened with the area under local anesthesia. The mucous membrane of the posterior wall of the maxillary fossa was separated, and the thin bony wall was removed with chisels, a dull hooklet and a curved curet. After dull dissection the internal maxillary artery was easily located in the fatty tissue of the sphenomaxillary fossa. The sphenopalatine artery was rather large. Double ligature was carried around the internal maxillary artery at its transformation into the sphenopalatine artery, and the vessels were severed. A large window was made in the inferior nasal meatus; the nasal packing was removed; a cigaret drain from the nose into the maxillary sinus was inserted, and the oral mucosa was closed with catgut sutures. Bleeding in the nose was completely checked by the end of the operation, and no further packing of the nose was necessary. A transfusion of 500 cc. of blood was given; calcium lactate, 1 Gm. six times daily, was given orally, and recovery was uneventful.

CASE 3.—A. B., a woman 52 years of age, with a blood pressure of 230, had posteronasal hemorrhage often. She was sent to the hospital with severe epistaxis of thirty-six hours' duration, which could not be controlled by nasal and postnasal packing. Exploration of the nose with the aid of para-normo-butylaminobenzol-di-methylamino-ethanol hydrochloride and epinephrine showed an abundant hemorrhage from the superior part of the right side of the nose. The nose was repacked, and the antrum and sphenomaxillary fossa, in which the well developed internal maxillary and sphenopalatine arteries were easily found by blunt dissection, were opened. Double ligature was applied to the internal maxillary artery near the sphenopalatine artery, and the vessels were severed with scissors. A large window was made in the inferior nasal meatus, and the oral mucosa was closed with catgut sutures, after a cigaret drain was arranged for the antrum through the inferior nasal meatus. In this case bleeding was not completely stopped after the ligature of the internal maxillary artery. However, it was much less severe, so that it could be easily controlled by the insertion of a finger cot which was inflated with air. After the operation intravenous injection of 500 cc. of a hypertonic (1.8 per cent) solution of sodium chloride and 1,000 cc. of the same solution administered by the Murphy drip method were given. The finger cot was removed on the following day without recurrence of bleeding. During the next few days the patient took 1 Gm. of calcium lactate orally, six times a day. Recovery was uneventful.

The nasal hemorrhage in this case was not completely stopped after the ligature of the internal maxillary artery, obviously because of the anastomoses with arteries originating in the posterior ethmoid artery, which is a branch of the ophthalmic artery.

COMMENT

The technic of the transmaxillary ligature of the internal maxillary artery is rather simple, especially when one makes a large opening into the facial wall of the antrum at the beginning of the operation. It is not so necessary to enlarge the opening toward the lateral side as it is

imperative to remove the bone as far as possible toward the edge of the apertura piriformis. Of course, the operation could be still more simplified if one performed a real Denker operation, that is, removal of the whole edge of the apertura piriformis. Even though I have never observed any inconvenience after this operation although I have performed it in a great number of cases, I find that it is not necessary to take away the entire edge of the fossa piriformis, but in order to have easy access to the anterior wall of the inferior medial border of the maxillary cavity, the incision in the oral mucosa should be made beyond the midline, so that the frenulum labii superioris is divided.

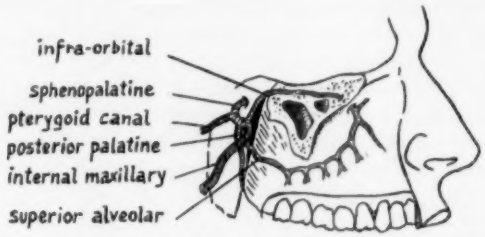

Fig. 1.—Diagram showing the position of the arteries.

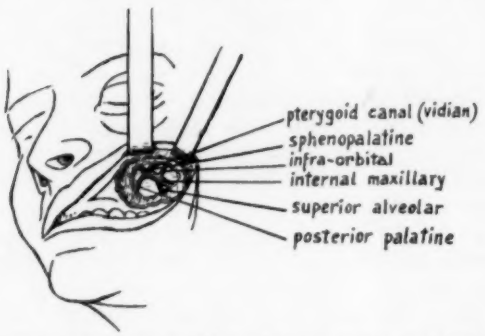

Fig. 2.—Diagram showing the position of the arteries in relation to the opening made for operation.

The topography of the internal maxillary artery and its branches in the sphenomaxillary fossa may easily be seen in figures 1 and 2.

Recently Gergely [2] has done minute research on the anatomic topography and surgical treatment of the internal maxillary artery in the sphenomaxillary fossa. According to his findings, the most convenient place for the ligature of the internal maxillary artery in relation to the origin of the infra-orbital artery from the main stem was in eight cases proximal as well as distal; in three cases ligation could be made only distally, and in one only proximally. According to Seif-

2. Gergely, Z.: Transmaxillary Ligature of the Arteria Maxillaris Interna, Acta oto-laryng. **22**:142, 1935.

fert, care should be taken to place the ligature as near as possible to the entrance of the nasal cavity, that is, near the sphenopalatine foramen, in order to avoid as many communications as possible. Gergely's investigations have shown that in most cases it is possible to satisfy this demand.

SUMMARY AND CONCLUSIONS

1. In cases of severe epistaxis in which the source of bleeding is not accessible, and which cannot be controlled by the ordinary means (such as the application of methylamino-aceto-ortho-di-oxybenzol, galvanocautery or electrocoagulation) or by packing with smoked bacon (according to M. L. Hurd), ligature of the internal maxillary artery in the sphenomaxillary fossa is the method of choice.

2. Transmaxillary ligation of the maxillaris interna artery is a technically easy procedure for the rhinologist who is accustomed to work with artificial light in deep-seated cavities.

3. Transmaxillary ligature of the internal maxillary artery can be done quickly with the area under local anesthesia, without a great additional loss of blood and without leaving any visible scars.

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NASAL VENTILATION IN DIAGNOSIS AND CONTROL OF HEADACHE

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Ephedrine in a physiologic solution of sodium chloride as an agent for local treatment of the nose and the sinuses during acute infection is well known.[1] Its value lies in its ability to shrink the respiratory mucosa and thus to restore ventilation of the nose and sinuses and function of the mucosa. Its use has received physiologic justification in that investigators have found it free from all evidence of harmful effect on ciliary function.[2] The same may be true of more recently introduced drugs, such as neosynephrin hydrochloride, if equal care is taken to prepare a physiologic solution. Such factors as isotonicity and neutral reaction are being given increasing attention as mucosal function is better understood.

A notable characteristic of ephedrine in physiologic solution of sodium chloride is that its local action is safe and is free from by-effects, such as surface anesthesia and interference with ciliary activity. Thus it differs from cocaine and epinephrine and for some purposes is preferable to them. It may be sprayed into the nose, the nasal fossae may be flooded with it with the patient in head-low posture and it may be made to enter the sinuses by displacement.[1a] Any or all of these procedures may be carried out with no local effect other than shrinkage of the mucosa. This is important because it permits certain conclusions to be drawn from the effect of improved ventilation alone.

In practice physicians often are confronted with the problem of long-standing recurrent headache. In a proportion of the cases one can

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1. (*a*) Proetz, Arthur W.: Displacement Irrigation of Nasal Sinuses, Arch. Otolaryng. **4**:1 (July) 1926; Further Data on the Displacement Method in Sinuses, Ann. Otol., Rhin. & Laryng. **36**:297, 1927. (*b*) Parkinson, Sidney N.: A Lateral Head-Low Position for Nasal and Sinus Treatment, Arch. Otolaryng. **17**:87 (June) 1933; Observations on Postural Treatment of Upper Respiratory Infection, J. Pediat. **6**:809 (June) 1935; Ephedrine in Physiologic Solution of Sodium Chloride and Lateral Head-Low Posture in Treatment of the Nose and Sinuses, Arch. Otolaryng. **23**:344 (March) 1936. (*c*) Gundrum, Lawrence K., and Semenov, Herman: The Treatment of Sinusitis by the Displacement Method, Using Ephedrin and Bacterial Antigens, Laryngoscope **45**:858 (Nov.) 1935.

2. Lierle, D. M., and Moore, P. M.: Effects of Drugs on Ciliary Activity of Mucosa of Upper Respiratory Tract, Arch. Otolaryng. **19**:55 (Jan.) 1934. Proetz, Arthur W.: Effects of Drugs on Living Nasal Cilia, Ann. Otol., Rhin. & Laryng. **43**:50 (June) 1934.

determine quickly and with considerable accuracy whether a headache is or is not of local origin by noting the effect of thorough ventilation of the nose and the sinuses. By "of local origin" I mean arising from such a known cause as undue positive or negative [3] pressure within a sinus or contact pressure of swollen intranasal structures. Headache of the neuralgic type is in this sense not usually of local origin, as it is not modified as a rule by ventilation alone. Obviously, a negative effect from ventilation is not as diagnostically reliable as a positive effect, because adequate ventilation may not have been obtained in the sinus at fault.

I believe that the possibilities of this aid in diagnosis are too little appreciated and that therefore it is not used to the extent that it might be. Shrinkage of the nasal mucosa and displacement of ephedrine solution into the sinuses ordinarily are easily and quickly carried out. For years I have used the lateral head-low posture [1b] for this purpose because it is based on the anatomy of the region to be treated and permits one to reach all the sinuses of one side or of both sides simultaneously. As an intranasal and intrasinus procedure it has the advantages of simplicity and directness, and it can be carried out entirely without discomfort. By its use the examiner is relieved to a considerable extent of dependence on such aids as tampons, applicators, probes and cannulas and thus can avoid the trauma, discomfort and subsequent reaction inherent in their use.

A few cases are cited to illustrate the use and value of ventilation alone in differentiating headaches as to site of origin and mechanism of production. Much of this value is attributable to the lateral head-low posture [1b] because of its simplicity and adequacy. This posture has been shown to make available for displacement simultaneously all the sinuses of one side or of both sides unless they are barred by hyperplasia or by other unshrinkable tissue.

Case 1.—Mr. B. P., aged 54, complained of bilateral headache in the occipital region, which had recurred from one to several times a week since boyhood. Onset occurred at any time of the day or night; the duration varied from several hours to a day or more, and the intensity was usually moderate, occasionally severe.

General examination revealed no cause; the only significant local finding was moderate congestion of the nasal mucous membrane, which was dull red.

A typical headache was present at the time of examination. Shrinkage of the nasal mucosa followed by displacement of 1 per cent of ephedrine in a physiologic solution of sodium chloride into the sinuses of both sides resulted in immediate disappearance of symptoms. Presumably then, the headache was of local origin and was due directly or indirectly to nasal congestion. The patient stated that he had been a heavy user of cigarets since boyhood. On the chance that tobacco

3. Sluder, G.: Nasal Neurology, Headaches and Eye Disorders, St. Louis, C. V. Mosby Company, 1927.

might be the cause of the nasal congestion, he was requested to stop smoking. He returned in a week without having had a return of headache, nor has he had a recurrence at any time since.

CASE 2.—Mrs. C. K., aged 46, complained of headache in the left hemicranial region, which had recurred with each menstrual cycle since she was 14. The headache started at the left side of the nose and radiated fanwise to include the entire left side of the head, becoming most noticeable in the cheek and the temple. Nausea and vomiting usually supervened, so as to cause disability for from one to three days. The headache usually preceded the menstrual flow and occasionally accompanied or followed it, but within the memory of the patient it had never failed to occur. A similar headache usually accompanied colds. For many years she had been aware of a discharge of mucus and occasionally of mucopus from the left side of the nose and had often noticed congestion on that side at the time of headache.

The nasal mucosa appeared somewhat pale and was slightly congested. The septum was deviated moderately to the left.

No headache was present at the time of examination; so the patient was asked to return as soon after the onset of the next one as possible. She returned a week later, one day before the scheduled onset of menstruation. The headache had begun after midnight, had rapidly increased in area and intensity and was soon accompanied by nausea and vomiting, which had continued at intervals throughout the morning. She was pale, weak and ill. The mucosa of the left side of the nose was congested, pale pink and wet with mucus. As soon as the nasal mucous membrane was shrunken, the headache began to disappear, and it left entirely after the displacement of a solution of ephedrine into the sinuses. The patient was instructed to keep the nose open with an ephedrine spray. The headache did not return until the following morning and then was mild. As before, it disappeared at once when treatment was given.

It seemed fair to assume from the findings that the headache was related to nasal congestion and that the actual mechanism might be contact pressure of swollen tissue or blockage of sinuses or both. The cause of the congestion appeared to be connected with the menstrual cycle.

A week later the nasal septum was straightened, the anterior portion of the left middle turbinate bone was removed and a naso-antral window was made. Two menstrual periods passed without headache for the first time in the patient's memory. Since then, however, headache of mild to moderate intensity has occurred at menstruation, especially if the patient has happened to have a cold.

This patient had been treated for years for migraine from the standpoints of allergy and glandular dysfunction.

CASE 3.—Mrs. R. W., aged 28, complained of headache in the left supra-orbital region, regularly premenstrual but also accompanying colds, for six years. Frequent nasal congestion occurred, particularly during the three years prior to examination. Mild bilateral frontal headache had occurred almost daily for a few months.

The nasal mucosa was found to be moderately congested, dull red and lusterless. There were no other important findings.

A headache of the usual type was present at the time of examination. Thorough ventilation of the nose followed by displacement of a solution of ephedrine into the sinuses gave prompt relief. This treatment was repeated on several occasions with the same results. It was assumed, therefore, that the headache resulted from nasal congestion from whatever cause—menstrual cycle, cold or allergy.

The patient was advised to use a spray of ephedrine to keep the nasal tissue shrunken and to have occasional treatments for the same purpose. She did not accept any suggestion of surgical intervention. For years she had been accustomed to having severe colds treated by repeated puncture of the antrum and lavage and had acquired a probably well founded dread of intranasal procedures.

In the two years prior to the time of writing she has had recurrence of the headache only four times, twice premenstrually and twice with a cold. Each time it has stopped promptly after thorough shrinkage of the nasal mucosa and ventilation.

CASE 4.—Mr. R. N., aged 26, complained of bilateral headache in the supra-orbital, retro-orbital and occipital regions. The first attack occurred more than four years before examination, and the attacks became progressively more frequent and more severe. For the year preceding examination he was seldom free from headache for more than a few hours at a time. He was unable to work. For years he had noticed an excess of postnasal mucus and moderate intermittent nasal congestion.

The nasal mucosa was found to be dull red and moderately congested. There were no other important changes.

At the first visit thorough shrinkage of the nasal mucosa followed by displacement of a solution of ephedrine into the sinuses gave no relief, and none was obtained by applying cocaine over the areas of the sphenopalatine ganglions. On the next day, however, shrinkage and displacement gave considerable relief within from ten to fifteen minutes. This procedure was repeated on three other occasions, and each time relief for several hours was obtained.

Because the headache was believed to be of the sinus vacuum type, originating from the sphenoid sinuses, a large window was made in the right sinus. No further headache occurred on the side on which operation was performed, but, as is common in such cases, it became more noticeable on the left side than it had been previously. After six weeks the left sphenoid sinus was opened wide. When the patient was seen six months later there had been no recurrence of headache on either side.

This patient had been treated by many physicians for migraine.

CASE 5.—Mr. C. M., aged 26, complained of bilateral headache in the supra-orbital and orbital regions irregularly recurrent since childhood. The headache was usually preceded by a transient loss of vision in the left half of the visual fields and by a sensation of shooting lights and was often accompanied by nausea and vomiting. Several other members of the family were said to have the same complaint. The patient had had considerable treatment on and off because of annoying nasal congestion but had not been benefited.

The nasal mucosa was found to be somewhat redder than normal and considerably congested.

The picture seemed to be that of familial migraine, with allergy as the most likely cause. It was of interest, however, to find that no amount of ventilation of the sinus and no local anesthetization had more than a momentary effect on the headache. It was evident that nasal congestion was not the mechanism by which the headache was produced. The patient's physician determined on wheat as the offending allergen, and its removal from her diet gave the desired relief.

CASE 6.—Mrs. E. D., aged 27, complained of bilateral headache in the retro-orbital and occipital regions, which had recurred irregularly several times a month for many years. The attacks lasted several days as a rule, were moderate to

severe in intensity and were apparently associated with nasal congestion. Since childhood she had had frequent, moderately prolonged colds, with much nasal congestion.

The nasal mucosa was dull red, moderately congested and somewhat edematous in places. No other significant changes were noted.

This headache usually could be relieved by thorough nasal ventilation followed by displacement of a solution of ephedrine into the sinuses. Occasionally, however, it was necessary to supplement this with application of cocaine to the areas of the sphenopalatine ganglions. As the symptoms appeared to indicate the sphenoid sinuses as the source of trouble, they were opened wide. There has been no recurrence of headache at the time of writing.

This patient had been treated for a long time for allergic migraine. If this diagnosis were correct, it would appear that the mechanism of production of the headache was that of allergic nasal congestion.

Case 7.—Mrs. E. G., aged 45, complained of headache in the retro-orbital and occipital regions and extending to the neck, shoulder and elbow on either side or on both sides but it was worse on the left. This headache had been of frequent occurrence for nearly fifteen years, the attacks lasting from one to several days. For as long as she could remember there had been nasal congestion and moderate postnasal discharge. At times she had noted definitely that increased nasal congestion accompanied the headache.

The nasal mucosa was dull red and moderately congested. The cervical vertebrae showed roentgenologic evidence of arthritic changes, which had long been assumed to be the cause of the headache.

Shrinkage of the nasal mucosa and the displacement procedure at times gave immediate relief, while at other times relief was obtained only after the application of cocaine to the areas of the sphenopalatine ganglions. It was assumed, therefore, that on the occasions when ventilation alone failed, it was because the sinuses at fault had not been ventilated or because sufficient irritation of the ganglions had occurred to set up a true neuralgia. In any event, after a window was made in each sphenoid sinus, the headaches ceased, and they have not recurred at the time of writing.

The value of shrinkage and displacement, using the lateral head-low posture, is never more appreciated than in the treatment of the pain accompanying acute frontal sinusitis. As a rule prompt relief from the symptoms can be given and free drainage of pus obtained. Moreover, the relief can usually be maintained without the necessity of resorting to intranasal instrumentation. Exceptions are encountered, as those instances in which a particularly bulbous middle turbinate bone so crowds the middle meatus that its fracture or removal is imperative.

Case 8.—Mr. J. A., aged 32, complained of bilateral pain in the frontal region, which had been present for one week. The onset occurred a few days after he contracted a severe cold. The headache began late each morning, lasted until evening and was severe. He was unable to work.

The nasal mucosa was dull red and moderately congested. Considerable tenderness was present over both frontal areas. All sinuses were very cloudy.

Shrinkage of the nasal mucosa followed by displacement with ephedrine in a physiologic solution of sodium chloride brought immediate relief and the discharge of much thick green pus. The patient was instructed to keep the nose open with

an ephedrine spray. Treatment by shrinkage and displacement of ephedrine solution into the sinuses was repeated for several days. There was no return of the headache, although drainage of purulent material continued for nearly two weeks.

I know of no intranasal condition in which the avoidance of probes, cannulas or tampons is more to be desired than in acute frontal sinusitis. Both the pathologic condition and the anatomic structure require that for the best results no trauma or irritation be permitted. This applies to irritating drugs no less than to instruments.

CASE 9.—Mr. M. G., aged 37, complained of pain in the left frontal region for two days, accompanying a cold of one week's duration. The pain had been continuous and severe, with copious drainage of yellow pus. During the twenty-four hours prior to examination swelling over the left brow had developed, including the upper eyelid, so that the eye was nearly closed.

The nasal septum was deviated to the left, making a narrow fossa on that side to a level well above the lower border of the middle turbinate bone. The nasal mucosa was bright red and moderately congested. Transillumination showed marked cloudiness over the left maxillary and frontal areas as contrasted with corresponding areas on the right side.

Shrinkage of the nasal mucosa with a 1 per cent solution of ephedrine followed by the displacement procedure with the patient in the lateral head-low position gave immediate relief from pain and caused the discharge of much thick yellow pus. The patient was advised to keep the nose open by the periodic use of an ephedrine spray. When he returned the next day, the swelling had almost disappeared and there had been no return of pain. The purulent discharge continued for a week, but there was no further discomfort despite the fact that the area of the frontal sinus did not appear clear for nearly two weeks.

REPARATIVE PROCESSES IN THE MEMBRANA TYMPANI

SOME INTERESTING MANIFESTATIONS

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EPIDERMAL ESCALATION

The ability of the membrana tympani to reconstruct itself is exceeded only by its failure to do so in some instances. In the same hour I have observed a minute perforation of several years' duration, and a "new growth" membrane which had formed after a radical operation on the mastoid, the membrane extending from the anterior wall of the canal to the posterior wall of the mastoid cavity, completely partitioning the tympanum, with a surface area about equal to that of a 5 cent piece. This membrane was perfectly transparent, apparently consisting only of the epidermal layer, growing posteriorly from a vestige of the anterior border, as proliferation proceeds only in this direction. How so frail and poorly nourished a reconstruction was possible when the minute perforation consisting of all the layers with an abundant blood supply failed to close can be explained on the basis of one fact. Although Politzer has shown that perforations can be closed by cicatrization of the mucous membrane, it has been established that epidermal proliferation is much more rapid. Hence, it may be presumed that the small perforation failed to close because the epidermis doubled back on the underlying layers, the substantia propria and the mucous membrane. In the larger wound the membrane, having no supporting structure, progressed in an orderly manner according to the rule which is set forth here.

In 1932 I made an observation which I believe to be original.

Case 1.—J. F. presented himself on Dec. 3, 1932, stating that while he was constructing a duck blind a few days previously a small reed entered the external canal of the left ear, presumably puncturing the drum membrane, as he felt a sharp pain followed by some impairment of hearing in that ear. Examination revealed a healing clean traumatic perforation of the drum on a level with the umbo and midway between it and the posterior margin. A small black object was embedded in the drum just posterior to the perforation. On Jan. 2, 1933, just a month later, the perforation was entirely healed. The foreign body was still present, with no inflammatory reaction; hence it was not disturbed.

On February 16 the drum was normal, but the foreign body had moved to the junction of the drum and the posterior wall of the canal, still on the same level

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as the umbo. On April 1, four months after the original observation, while treating the patient for acute rhinitis, I examined the ear. The foreign body, still embedded in the epidermis, was found on the posterior wall of the canal on a level with the umbo, having traversed fully two thirds of the distance from the membrane to the external meatus. It was removed and proved to be fibrous vegetable matter, probably the tip or bark from the reed which caused the original perforation.

Since then I have repeatedly observed the same phenomenon of extrusion of foreign bodies, several instances of which, while merely corroborating the original observation, are interesting to relate.

Case 2.—Mrs. R. M. stated that she had a sharp pain in the right ear, followed by a feeling of fulness. Examination revealed a slightly injected drum, with a blood clot just behind the malleus. Within seven days this clot had migrated to the junction of the membrane and the canal, and two weeks later it had reached the meatus.

Case 3.—J. M. had a perforation in the postero-inferior quadrant of the right drum with a subacute discharge. Insufflation of boric iodide powder resulted in dryness of the ear the next day, although the perforation, about 2 mm. in diameter, remained patent. In the course of the next ten days the entire perforation, still patent, was seen to migrate to the posterior junction of the membrane and the canal, the membrane then closing and a crust eventually being evacuated from the meatus.

Case 4.—A 12 year old boy ruptured his drum in June 1933, while diving. The tear closed without incident in a few days, and to my certain knowledge, the drum was normal in September.

On Nov. 2, 1933, while attending him for acute rhinitis, I observed a jagged perforation in the posterior portion of the drum. There was no inflammation or discharge, and it was assumed that the rupture was probably the result of too strenuous blowing of the nose.

On November 6, the rhinitis having resolved, a small piece of Cargile's membrane was moistened and placed over the perforation. Under close observation the perforation was seen to close beneath the Cargile membrane, the artificial membrane then beginning a migration to the wall of the canal.

On November 29 the membrane was almost to the meatus, and on December 15 it was picked out of the meatus with the fingers.

Bearing in mind that in all these cases there was a definite migration of the epidermal coat from front to back and that all these artefacts were located below Shrapnell's membrane, I believe that the following instance is significant.

Case 6.—On March 5, 1927, an 8 year old girl, Grace C., complained of "deafness" of several months' duration. The tonsils and adenoids had been removed, and the nasopharynx was clean. The right drum was opaque and slightly congested, with some retraction of Shrapnell's membrane. No perforation, scarring or fluid was seen under magnification.

Tests of hearing with tuning forks revealed about 50 per cent reduction of hearing of the conductive type in the right ear. Politzerization with pneumomassage was repeated weekly until April 25, 1927, at which time the hearing was normal.

On April 9, 1932, five years later, the patient appeared with a recurrence of impairment of hearing in the right ear of about two weeks' duration. In the elapsed time there had been no difficulty. With the present attack there was no history of pain, discharge or tinnitus, nor had there been any recent acute rhinitis.

Examination.—The membrana tympani was transparent, and there was no congestion. There was a perforation in Shrapnell's membrane disclosing the head of the malleus. There was no discharge, but the margins of the perforation were encrusted with dried serum. This was removed. On four subsequent examinations, at intervals of one week, no more crusting was observed, but neither did the margins of the perforation show any proliferation.

A piece of Cargile's membrane slightly larger than the perforation was cut, thoroughly moistened and teased over the opening, the edges then being "ironed out" with moist cotton applicators. The patient remarked on the immediate improvement in hearing. Three months later the artificial membrane was still in situ, but the edges were rolled up and the center was wrinkled. It was removed by again moistening it. The perforation had closed, and the hearing was normal.

Comment.—This was undoubtedly an instance of catarrhal otitis media. Politzer [1] said concerning spontaneous perforation:

> The author has been able to observe its development during the course of a chronic middle ear catarrh; this was due to the fact that a deep groove was formed above the processus brevis in consequence of a marked retraction of the atrophic pars flaccida and its apposition to the neck of the hammer, whereupon the growth of the epidermis of the external meatus into this depression caused a continuous pressure upon the pars flaccida, thereby creating a perforation.

The significant fact is that whereas foreign bodies or artefacts below the striae were escalated posteriorly and out along the wall of the canal, this one in Shrapnell's membrane remained in situ, there apparently being no definite current.

With this difference in mind I marked the drum membrane in various locations with india ink in a series of cases. I am now able to set forth definite laws of proliferation:

1. The epidermis on the membrana tympani does not proliferate and desquamate haphazardly. It migrates on its original plane from the anterior margin to the posterior wall of the canal and then out along the wall of the canal to the meatus. This probably explains why a drum which has undergone repeated incisions in childhood frequently retains no evidence of scarring in later life.

2. The epidermis of the membrana flaccida fans out over the wall of the canal. Thus, a dot of india ink is broken down into small particles which move radially from the original locus.

3. The proliferation of the epidermis around the processus brevis is likely to proceed in whorls, but the movement tends to be toward the superior wall of the canal rather than toward the posterior wall. Thus,

1. Politzer, A.: A Text-Book of Diseases of the Ear for Students and Practitioners, ed. 6, London, Baillière, Tindall & Cox, 1926, p. 393.

a dot placed just anterior to the short process moves in a circular posterior direction, first crossing the handle of the malleus below the short process and then turning upward to be carried to the superior wall of the canal with some slight spread of the particles of ink.

4. The rate of progress is not uniform but is more rapid in the postero-inferior quadrant.

5. In no instance have I been able to observe proliferation from the canal toward the drum. This is a marked contradiction of the accepted statement that cholesteatoma in the posterior quadrant and the attic is caused by an ingrowth of epidermis from the wall of the canal. It must also be an important factor in the failure of anterior or "tubal" perforations to close.

CLOSURE OF PERFORATION WITH THE AID OF AN ARTIFICIAL MEMBRANE

Although as early as 1640 artificial membranes were used as aids for hearing in instances of perforation of the membrane, little attention has been devoted to them as a valuable adjunct in causing perforations to close.

I have found Cargile's membrane or the ordinary fish skin condom an ideal material for this purpose, and I have succeeded in closing surprisingly large perforations, even of many years' duration, through its use.

It must be applied only in an entirely dry ear in which there is no inflammatory reaction, must itself be protected from external moisture in bathing and must be watched for intolerance on the part of the middle ear. In my experience I have seen no evidence of intolerance created, except in a few instances in which inflammation already existed.

When it is applied moist, the membrane becomes tense on drying and so nearly resembles the normal membrane that it is almost impossible to recognize its artificiality unless one uses magnification, such as that obtained with the electric otoscope or the aural microscope.

In old perforations the margins are first freshened with a caustic; twenty-four hours is allowed for the resultant inflammation to resolve, and then a small piece of artificial membrane is applied which closes the perforation immediately. The patient usually remarks on the instant improvement in hearing.

Frequently approximation of the margins of the perforation can be watched through the artificial membrane. If the perforation is below the striae, the artefact will be ejected by the escalatory effect previously described. Otherwise it must be removed by moistening. In any event it may remain in situ indefinitely without causing an unfavorable reaction.

DIABETIC ENDARTERITIS OF THE MUCOSAL LAYER

CASE 7.—Clara P., aged 11 years, was seen in January 1932 in a state of diabetic coma. There was marked dry congestion of the nose and throat. Both tympanic membranes, though transparent, had a uniform "red glow," which I am wont to describe as the reflection of a red pharynx. The landmarks were visible, there was no retraction or bulging, and the epidermal vessels were not congested. When looked at at a tangent the epidermal layer showed its normal luster, additional evidence that the red glow was due solely to congestion of the mucosa.

On the next day the appearance was the same, except that in the right ear, about the center of the posterior quadrant, there appeared to be a small fragment of broken glass lying on the drum. The edges were irregular, angular and sharply cut, while the body was translucent. The suffused red glow was still present in the remainder of the drum. Manipulation with the Siegel otoscope produced no change. On closer inspection with magnification, the epidermal layer was seen to be intact, the appearance of depth of the peculiar area being given by the rolled edges of the mucosa, the break in continuity accounting for the loss of color in this area.

The left drum was still red.

Two days later the translucent area had disappeared, but there were two similar though smaller areas in the left drum.

The following day the area had reappeared in the right drum, while those in the left remained.

There was no change for seven days, except that the red glow gradually faded. On the eighth day the membranes were normal, without the slightest evidence of the former lesions. Incidentally, the child was out of the coma with little remaining acidosis. The membranes have been under frequent observation since 1932, and no recurrence of the lesion has been observed. Neither a scar nor an atrophic area remains, showing that the substantia propria was not involved.

An interesting feature is that these lesions disappeared overnight and not by gradual advancement of their borders. That is, the evening examination would show no change, while on the following morning there would be absolutely no evidence of any lesions ever having existed. The possibility of its being an optical illusion created by a drop of clear serum in the middle ear or by moisture on the epidermal layer was considered. Against this were the angular margin, the lack of magnification of the underlying tissue and the fact that the patient frequently changed position, rolling and tossing on the bed at times. I can account for this lesion in no other way than by a break in continuity in the mucosa due to occlusion in the circulation, relaxation in tension producing the rolled borders, while retraction of the drum during phases of negative intratympanic pressure allowed the margins to fold back in place long enough to adhere. Also, it is possible that sudden release of the obstructed circulation with a rush of blood to the collapsed vessels resulted essentially in an "erection" which unrolled the margins and bound them together.

Additional weight is added to the latter hypothesis by the fact that some pathologists question the existence of diabetic endarteritis, con-

tending that the vascular change in diabetic persons is due to embolism from hyperlipemia rather than to endarteritis from hyperglycemia.

HYPERKERATOSIS OF THE EPIDERMAL LAYER

While cholesteatoma of the external canal in chronic otitis media is not rare, such a lesion occurring on an intact membrana tympani with no other pathologic change is unique in my experience.

CASE 8.—The patient was seen on Jan. 22, 1930, complaining of tinnitus and a "heavy" feeling in the left ear. The history and examination indicated that the ear, nose and throat were essentially normal except for this ear. In the anterior inferior portion of the drum was a slightly rounded umbilicated lesion resembling a brown pigmented mole. The remainder of the drum was normal, except for being slightly darker than usual. When the lesion was palpated with a cotton-covered probe, one edge was rolled away from the drum, showing that the periphery at least was not firmly attached. By gentle manipulation the entire "tumor" was finally dislodged.

This tumor was cone shaped, with the apex against the drum, and had the consistency of rubber. The base, or external surface, 4 mm. in diameter, had the appearance of tan pebbled leather, slightly convex and umbilicated in the center, with thin flat edges. The sides of the cone were grayish white and flaky.

The area on the drum membrane to which the lesion had been attached showed a marked depression, or dimpling, and was desquamating but intact.

The tumor was sent to the laboratory for section but, unfortunately, it was lost.

Two weeks later the drum membrane had regained its normal position, but showed slight scaling in the affected area. The tinnitus was gone, and tests showed the hearing to be normal.

In September 1933, tinnitus having reappeared, the patient returned. A lesion had recurred, identical in every detail with the original one, except that it was slightly smaller. This tumor was removed and sent to the Army Medical Museum for examination.

Pathologic Report.—After making an examination the pathologist presented the following report: "An examination of the tissue from your patient, W. H., does not reveal any evidence of tumor in the tissue received. The microscopic sections show laminated masses of necrotic desquamated epithelium and a small amount of amorphous material, containing clumps of bacteria. This suggests a desquamative lesion from the surface of the drum. However, these slides show no evidence of inflammatory infiltration to account for this process. This examination does not exclude the possibility of a primary cause being present in the middle ear."

Course.—One year later there had recurred a lesion about one-half the size of the original growth. As the succeeding year produced no increase in size, I have left it in situ. There has been no tinnitus, pressure symptoms or impairment of hearing.

I am at a loss to explain this formation except on the basis of some interference with the normal direction of proliferation. Probably there had developed a block to the normal anteroposterior escalation of the epidermis, producing a piling up in this region.

THE PANSINUS OPERATION FOR ASTHMA

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For many years the value of various operations on patients with chronic hyperplastic sinus disease for the relief of asthma has been a greatly debated problem. There has been and remains a marked difference of opinion between the proponents of the conservative treatment of asthma and those of the radical type of surgical intervention. It is planned to report here the effect of the pansinus operation on thirteen patients with markedly advanced chronic hyperplastic pansinusitis associated with asthma. In every case the operation consisted of a bilateral fronto-ethmosphenoidectomy and the Caldwell-Luc operation. This extensive surgical procedure was not done on account of the asthma but was performed primarily for the relief of symptoms of the sinus disease—that is, severe headache, marked nasal discharge or toxemia—and to lessen the probability of the development of complications, such as meningitis or abscess of the brain.

ETIOLOGIC RELATIONSHIP OF SINUS DISEASE TO ASTHMA

Until recent years chronic sinus disease has been generally regarded as a frequent cause of asthma. As a result the sinuses have been attacked by all the various types of operation, both conservative and radical, with the hope of curing the asthma. With this in mind some writers [1] have reported marvelous success in the relief of asthma by means of operation on the sinuses. However, by far the larger number [2] have found it necessary to be content with fair or even poor success,

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Clinical data were obtained from patients at the University Hospital, while the author was Instructor in Otolaryngology at the University of Michigan.

1. Lorie, A. J.: J. Missouri M. A. **16**:113, 1919. Bishop, V. L.: Ann. Otol., Rhin. & Laryng. **36**:410, 1927. Smith, F. R.: Asthma: Its Etiology and Surgical Treatment, Ann. Otol., Rhin. & Laryng. **38**:1095, 1929. Potts, J. B.: Etiology of Asthma: Relation of Sinus Infection to Asthmatic Attacks, Arch. Otolaryng. **12**:72 (July) 1930.

2. Weille, F. L.: Studies in Asthma, J. A. M. A. **100**:241 (Jan. 28) 1933. Dundas-Grant, James: Practitioner **119**:341, 1927. Brown, J. M.: Ann. Otol., Rhin. & Laryng. **26**:397, 1917. Dennis, F. L.: ibid. **33**:450, 1924. Stout, P. B.: J. A. M. A. **89**:1186 (Sept. 10) 1927.

while a large group[3] were extremely doubtful of the value of such operations in the treatment of asthma. The failure to relieve the asthma in such a large number of patients was attributed to the incompleteness of the operation, that is, the failure to remove all diseased tissue from the sinuses. Recently, there has been a change of ideas concerning the relationship of chronic sinus disease to asthma. The beneficial effects of cleaning up the sinuses have been so uncertain and variable that it is as yet difficult to say just what part the sinus disease plays in bronchial asthma. Is it cause; is it effect, or are both from the same undetermined cause?

Of the thirteen cases reported here, the asthma was cured in only three, or 23 per cent. The condition of three other patients was definitely improved, although the asthma was still present. The remaining seven, or 54 per cent, showed absolutely no improvement; in fact, the asthma in a few was worse after the operation. At the time of writing the three patients whose condition was cured have gone four years without recurrence of asthma. The remaining patients have also been under observation for four years since the operation.

As was previously stated, a most complete fronto-ethmosphenoidectomy, with the Caldwell-Luc operation, was done on both sides in every instance. All contents and mucous membrane of the sinuses together with all removable diseased bone were meticulously removed, yet I do not believe that one could call the final result successful as far as the asthma was concerned.

A study of the type of asthma and the character of the sinus disease in this series of cases revealed many interesting facts. The asthma had been present for from seven months to twenty years. The patients whose asthma was cured were predominantly those who had recently acquired asthma and sinus disease, whereas those whose condition was unimproved had involvement of longer duration.

Of the thirteen patients, six stated that sinus disease preceded the asthma, five noticed that the onset of the asthma and that of the sinus disease occurred at approximately the same time and two stated definitely that the asthma preceded the sinus disease by several years. The asthma was of the intrinsic type in all cases. Thus, in over 50 per cent of this group the asthma and the sinus disease developed together and appeared to be the result of the same cause, namely, allergy. As for the other 50 per cent, who stated that the symptoms of involvement of the sinuses preceded the asthma, one must keep in mind that a large

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number of patients cannot differentiate between sinus disease and vasomotor rhinitis and may state that they have had sinus disease for many years when in reality they had only the latter. I found that all patients in this series had characteristic symptoms of vasomotor rhinitis before the onset of asthma or suppuration of the sinuses. It seemed probable that in a large percentage of patients who stated that the asthma was preceded by the sinus disease, the two conditions really occurred about simultaneously. This, of course, adds further to the suggestion that both asthma and hyperplastic sinus disease are the result of some other cause and that asthma is not the result of hyperplastic sinusitis.

The histopathologic changes in the mucous membrane and the underlying sinus walls were essentially the same in all patients. There were epithelial hyperplasia, edematous infiltration and fibroblastic proliferation of the subepithelial stroma of the mucous membrane. There was also cellular and bacterial infiltration of the tunica propria and frequently even in the periosteum and underlying bone, including a high content of eosinophils, neutrophils, lymphocytes and plasma cells.

Direct macroscopic inspection of the sinuses at the time of operation revealed the presence of large polyps, hyperplastic lining membrane and free pus in all the sinuses of seven patients. The remaining patients had the same gross pathologic changes in all sinuses except one in each patient. The sinus most frequently free from polyps was the sphenoid, and next in order was the frontal. These sinuses, although free from polyps in a few cases, invariably showed a considerably thickened, diseased mucous membrane lining. The ethmoid sinuses of every patient were filled with pus and polyps, and in only one instance was an antrum free from the same condition. These findings demonstrate that with a few minor exceptions the disease process is an extremely extensive one and almost invariably involves all the sinuses, especially in the later stages of the disease. The widespread involvement of all or nearly all the sinuses is characteristic of patients with an allergic constitution, indicating perhaps that it is this underlying abnormal constitutional state with its permanent and transient edematous reaction of the mucous membrane of the nose and accessory nasal sinuses as a whole which predisposes to impaired natural drainage and ventilation, decreased resistance of the mucous membrane and finally secondary invasion of bacterial organisms. How different is this process from the simple suppuration which remains localized in one sinus or perhaps in adjacent sinuses, which is not associated with the allergic constitution, but which follows an acute sinus infection and which is usually the result of impaired drainage from the sinuses due to a septal spur or deviation or to enlargement of the turbinate on the affected side. In the latter type of sinusitis one does not ordinarily find the extensive bilateral

involvement of all the sinuses, and rarely does one find the marked polypoidal formations characteristic of allergic or hyperplastic sinus disease.

It is of interest to note that the clinical appearance of the nose was an accurate criterion of the pathologic changes in the sinuses. All patients except one presented both nasal cavities filled with large polyps and free draining of pus from the middle and the upper meatus.

RELATION OF ROENTGEN FINDINGS TO OPERATIVE FINDINGS

Although the roentgenograms actually revealed the presence of extensive disease of the sinuses in a large majority of patients, it was noted that the roentgenogram failed to show clouding of sinuses that were proved to be filled with polyps and pus. In two instances only the antrums and the ethmoid sinuses were cloudy on roentgen examination, whereas all the sinuses were found to contain polyps and pus at operation. This fact must be kept in mind when one is inclined to rely too greatly on roentgen findings alone in the determination of therapy for a sinus.

Every patient in this series had submitted to one or more intranasal operations, varying from nasal polypectomy to complete intranasal ethmoidectomy, without any improvement in the asthma and only temporary improvement of the sinus infection. Even after extensive intranasal surgical intervention in many of these cases there was invariably a recurrence of large nasal polyps and of suppuration in the sinuses, as evidenced by their presence later at the time of the complete external operation on the sinus. This suggests the total inability of the conservative intranasal operations to eradicate chronic hyperplastic pansinusitis in the advanced stages. The same objection was not present when the external approach to the sinus was used. Thorough postoperative follow-up revealed that all patients were free from active sinus infection after the complete external operation. The headaches had disappeared, nasal obstruction had been removed, purulent nasal and postnasal discharge was no longer present and the cavities of the sinuses appeared clean and healed. On postoperative examination the sinuses, when viewed through the nose, were covered with a thick, clean, nonulcerated cushion of pinkish lining membrane which was free from gross infection. Microscopic examination of this lining membrane disclosed it to be several times thicker than the normal epithelium of the sinus. The mucosa in some areas consisted of stratified columnar epithelium, but more frequently of stratified squamous epithelium, showing that both types are to be found even in the same specimen of tissue. Beneath the mucosa, which was of fairly normal thickness, was a greatly thickened submucosa, which consisted of an extensive fibroblastic proliferation and edematous infiltration. The submucosa was

vascular, and there was also considerable infiltration with plasma cells, lymphocytes and especially eosinophils. This microscopic study, except for lack of suppuration, revealed the same picture of edema, hyperplasia and infiltration with eosinophils which characterized the mucous membrane of the sinuses before the radical operation had been done and disclosed the characteristic allergic response of this newly formed lining membrane to the basic allergic constitution of the patient. It is logical to believe that the absence of suppuration and active infection in this newly formed mucous membrane removes the possibility that the sinuses operated on exert any etiologic influence on the persistence of the asthma, but, as I have noted, the asthma persists in the majority of cases.

In none of these cases was the patient's sinusitis or asthma greatly improved by a long therapeutic regimen consisting of vaccine made from the sputum and nasal secretions and a careful program of elimination, although complete studies of allergic reaction had been made, and in every case the patient was found to be sensitive to numerous foods and inhalants.

Chronic hyperplastic pansinusitis as a specific etiologic factor in asthma is further made questionable by a study of forty other cases of hyperplastic sinusitis in which the disease had been present from two to thirty years and in which not one of the patients acquired asthma.

These forty patients likewise had undergone a complete external fronto-ethmosphenoidectomy and the Caldwell-Luc operation on one or both sides. The pathologic changes observed in the nose and sinuses on clinical examination before operation and on direct inspection of all the sinuses at the time of operation were identical in every respect with the pathologic changes in the nose and sinuses of the asthmatic patients. Furthermore, the microscopic changes observed in the contents of the sinuses of the asthmatic patients were identical in every respect with those of the nonasthmatic patients. Further observation also revealed that the forty patients could be shown to be definitely of the allergic type when studied carefully by means of multiple cutaneous tests. They were proved to be sensitive to the numerous foreign proteins to which the allergic patients are usually sensitive. Although a large majority of the forty showed clinical and roentgenologic evidence of chronic bronchitis and some of bronchiectasis also, in none was there any evidence of asthma.

SUMMARY AND CONCLUSIONS

1. Chronic hyperplastic pansinusitis is fundamentally caused by decreased resistance of the lining of the sinuses to bacterial invasion as the result of the presence of an allergic or sensitized reaction of the

mucous membrane of the sinuses, which is one phase of the general allergic constitution of the patient.

2. Several observations suggest that chronic hyperplastic pansinusitis is not the cause of asthma but that both are probably the result of the patient's allergic nature in a large majority of instances.

3. Complete exenteration of all the contents of the sinus by the external approach in a series of thirteen patients with asthma caused disappearance of the asthma in only a small percentage of patients, although the sinus infection was thoroughly eradicated.

4. Conservative intranasal operations in advanced chronic hyperplastic pansinusitis do not completely remove the sinus disease, although they may temporarily relieve the patient's symptoms of both sinusitis and asthma.

5. If one is to hope for any considerable relief of asthma by the elimination of sinus infection, one must not delay until the sinus disease has reached its advanced stage.

CONGENITAL SHORT ESOPHAGUS

WITH PARTIAL THORACIC STOMACH

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A description of congenital short esophagus is not to be found in the general or special textbooks. While it is reasonable to suppose that this condition is not rare, only a small number of cases have been reported. Reports concerning this entity have appeared since 1930, cases having been described by Kelly,[1] Findlay and Kelly,[2] Jacob, Tweedie and Negus,[3] Wright,[4] Monkhouse and Montgomery [5] and Clerf and Manges.[6]

Since the deficiency in the length of the esophagus is made up by a portion of the stomach, the term "partial thoracic stomach" has been annexed to it. This term is used to distinguish the condition from hiatal or para-esophageal hernia, in which a portion of the stomach herniates through the hiatus and in which the esophagus either is below the diaphragm or is carried into the thorax with the herniated stomach. The esophagus, however, either straight or distorted is of normal size.

Since 1919 several instances of short esophagus have been accidentally discovered at postmortem examination. Of great interest however, are the report of a necropsy by Jacob, Tweedie and Negus [3] and another by Wright,[4] because a correct diagnosis was made during the life of the patients and because of the histologic studies.

Entrance thesis to the Chicago Laryngological and Otological Society.

1. Kelly, A. Brown: Congenital Stenosis of the Esophagus in Children Associated with Diaphragmatic Hernia of the Stomach, J. Laryng. & Otol. **45:** 680-685 (Oct.) 1930.

2. Findlay, Leonard, and Kelly, A. Brown: Congenital Shortening of the Esophagus and the Thoracic Stomach Resulting Therefrom, J. Laryng. & Otol. **46:**797-816 (Dec.) 1931.

3. Jacob, F. H.; Tweedie, A., and Negus, V. E.: Congenital Shortening of the Esophagus, J. Laryng. & Otol. **48:**486-488 (July) 1933.

4. Wright, J. A.: Congenital Short Esophagus, J. Laryng. & Otol. **48:**773 (Nov.) 1933.

5. Monkhouse, J. P., and Montgomery, S. K.: A Report of Seven Cases of Partial Thoracic Stomach with Short Esophagus, J. Laryng. & Otol. **48:**743-753 (Nov.) 1933.

6. Clerf, L. H., and Manges, W. F.: Congenital Anomalies of the Esophagus with Special Reference to the Congenitally Short Esophagus with a Portion of the Stomach Above the Diaphragm, Ann. Otol., Rhin. & Laryng. **42:**1058-1068 (Dec.) 1933; The Congenitally Short Esophagus, J. A. M. A. **102:**2008-2012 (June 16) 1934.

The first autopsy report concerns a child 1 year and 8 months old who died after the administration of a general anesthetic, and the other, a child 7 years old who died as a result of rupture of the esophagus due to forcible dilation.

In both instances a stricture was found in the esophagus just below the bifurcation of the trachea. It communicated above with a somewhat dilated portion and below with another dilatation which proved to be a part of the stomach within the thoracic cavity. The histologic studies of the tissues removed from the stricture and from areas above and below it proved that the tissue just below the stricture was a part of the stomach.

Three important findings are worthy of emphasis: 1. While the walls bounding the stricture in one case measured 7.5 mm., the coats of muscle measured only 2 mm., the rest consisting of firm scar tissue. This thickening evidently did not represent the so-called disputed sphincter, which is said to be located at the cardiac end of the stomach, but was the end-result of the ulcerative process. 2. There was no evidence of a peritoneal sac alongside of the esophagus above the diaphragm. The serous coat reflected from the cardiac side of the stomach to the under-surface of the diaphragm. This finding definitely differentiates this entity from hiatal hernia, with which it is confused. 3. The hiatus was enlarged to accommodate the passage of the stomach into the thorax.

It may be noted that the wide hiatus has no part in the etiology of congenital short esophagus, although it may be contributory to the formation of a true hiatal hernia or to the supradiaphragmatic stomach, which has been described by Jackson.[7] In the latter condition, in which the esophagus is also somewhat shortened, a differentiation from a congenital short esophagus is difficult and is only of academic interest. It may be stated parenthetically, however, that the erosion is usually found at the hiatal site of the supradiaphragmatic stomach, while in congenital short esophagus the ulceration is located above the diaphragm and usually at the junction of the esophagus with the stomach.

The transition of the esophageal mucosa into that of the stomach may occur without any evident pathologic change. This may account for the mild symptoms of distress and flatulence complained of by the patients, the real cause being accidentally discovered at autopsy. In some cases, however, this transitional area may be marked by ulceration during the early or the adult life of the patient. The ulcers are subject to frequent hemorrhage and to various degrees of fibrosis.

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7. Jackson, Chevalier, and Jackson, Chevalier L.: Peroral Gastroscopy, Including Examination of the Supradiaphragmatic Stomach, J. A. M. A. **104:** 269-275 (Jan. 26) 1935.

The symptoms have been described in detail by some of the aforementioned authors. Briefly stated, the severity of the symptoms depends on the extent of the ulcerative and fibrotic processes and on the action of the acid contents of the stomach on the esophagus. The symptoms are a feeling of pressure in the chest, pain, dysphagia and loss of weight. I may also add that the contraction waves and the presence of more or less air in the thoracic stomach act on the heart and lungs, thus giving the sensation which has been described by my patient as one of smothering.

With the formation of a stricture, which becomes unyielding to solid food, there is an onset of symptoms of esophageal stenosis. In adults it results in a gradual loss of weight, while in infants it may lead quickly to extreme emaciation. In the final analysis, however, none of the aforementioned symptoms are pathognomonic of this congenital anomaly.

Many patients with this condition have therefore been treated for pyloric stenosis, bleeding gastric ulcer, cholecystitis and malignant disease of the esophagus or the stomach. Various operative measures that followed as a result of these errors have therefore been in vain. The nearest approach to a correct diagnosis in the very young patient has been that of congenital stricture of the esophagus.

The accidental discovery of a backflow of the barium sulfate into the esophagus during the fluoroscopic examination of the stomach has led roentgenologists to further investigation of the lower end of the esophagus. With the adoption of the Trendelenburg position and at times by having the patient swallow the barium sulfate while in that position, a better filling and retention of the barium in the esophagus was obtained.

However, the pouch above the diaphragm outlined on the roentgenogram has been interpreted by roentgenologists as a diverticulum of the esophagus or as a gastric hernia, while the coexisting stricture has been explained, depending on the age of the patient, as congenital or as a malignant growth.

The credit for establishing the correct diagnosis of congenital short esophagus with secondary stricture is due to the esophagoscopic examination and to the biopsy sections that were obtained during this procedure. The verification of the diagnosis at autopsy has helped to establish this as a distinct entity.

To summarize, a diagnosis of congenital short esophagus is made from the changes observed by combined roentgenologic and esophagoscopic study, to wit: (1) the finding of a strictured area on the roentgenogram, usually between the sixth and the eighth dorsal vertebra, without any attributable cause for it in the history of the patient; (2) a peculiar hour-glass-like appearance of the esophagus on the roentgenogram obtained by adopting a special technic for the study of its

lower end; (3) the straight course of the esophagus shown by the roentgenogram and by esophagoscopic examination, and (4) the finding of gastric mucosa in the biopsy section obtained from the ulcerated and strictured area of the esophagus above the diaphragm.

When there are objections to the performance of esophagoscopic examination, the roentgenologic findings described here should be tentatively accepted as indicative of a congenital short esophagus. By considering the possibility of this anomaly one may avoid subjecting the patient to the risk of a surgical operation.

Although my limited experience with esophagoscopic examination of children (the youngest being 3 months old) may not reassure others of its safe performance, it is my belief that in the hands of an experienced endoscopist it is a less serious procedure than a bronchoscopic examination performed on an infant for the removal of a foreign body.

The treatment of the nonobstructive types consists of the use of alkalis, small feedings to be well masticated and, when possible, the assumption of an upright position or walking after meals. The successful treatment of the stricture depends mainly on repeated dilation. Gastrostomy with retrograde bougienage may become necessary when the stricture is extensive, especially in a child. This procedure is much safer than the dangerous forcible dilation which is attempted at times because of the apparent urgency when the nutrition is much impaired.

REPORT OF A CASE

Mrs. S. W., aged 70, was referred by Dr. Emil Ries, of the otolaryngologic service of Post Graduate Hospital, on April 23, 1934, for endoscopic study of the esophagus. It was noted in the patient's history that since childhood she had experienced frequent attacks of nausea and vomiting which gradually became worse at the age of 35. Difficulty in swallowing came on about eight years before examination, when solid food produced attacks of choking and vomiting. She felt great distress over the precordium after the ingestion of an ordinary meal and described the sensation as a feeling of being smothered. Within the year preceding examination she had lost 10 pounds (3.7 Kg.). Her condition had been treated in the past as disease of the gallbladder and as gastric ulcer, with only occasional relief from the symptoms. She presented herself for examination because of the fear of possible malignancy of the condition.

The roentgenologic diagnosis was that of a malignant growth of the esophagus at the level of the sixth dorsal vertebra. During the fluoroscopic examination of the stomach it was noted that the barium sulfate was flowing back above the diaphragm. On subsequent studies of the esophagus with the patient in the lying position, a pouch which communicated with the esophagus was outlined above the diaphragm. This led to the diagnosis of carcinoma of the esophagus associated with a gastric hernia.

At esophagoscopic examination, performed with the area under local anesthesia, an ulcerated strictured area 5 mm. in width was encountered 31 cm. from the incisor teeth. This area was covered with clean-appearing granulation tissue. The esophagoscope was passed onward without any resistance into a large sac, from which clear fluid was aspirated. The lining of the pouch, its color and the direction of the folds differed entirely from those of the esophagus and strongly

Fig. 1.—A reproduction of one of the roentgenograms which demonstrates the straight course of the esophagus. A pouch above the diaphragm, which is a part of the stomach, shows an air bubble.

Fig. 2.—Photomicrograph of a biopsy section of the esophagus obtained from the ulcerated area 31 cm. from the incisor teeth, showing typical gastric mucosa; × 126.

suggested those of gastric mucosa. Since the normal position of the constriction of the diaphragm had not been passed by the esophagoscope, a check on the reading scale was again made to ascertain whether its position was above the diaphragm. A specimen for biopsy was taken from the ulcerated area.

The patient felt much improved after the esophagoscopy. Subsequent dilations of the stricture resulted in a gain of the weight lost and of an additional 5 pounds (2.3 Kg.).

The microscopic section revealed that the tissue was lined by columnar epithelium with gland structures below it characteristic of gastric mucosa. The finding of gastric mucosa 31 cm. from the incisor teeth with a straight course of the esophagus on the roentgenogram and the rapid improvement of the patient definitely classify this as an instance of congenital short esophagus with a partial thoracic stomach complicated by a stricture.

SUMMARY AND CONCLUSIONS

There are patients who present vague symptoms which often simulate those of pyloric or esophageal stenosis, gastric ulcer, disease of the gallbladder and similar conditions.

The roentgenologic studies which show a stricture or dilatation of the esophagus and at times evidence suggestive of herniation of the stomach are not conclusive in establishing a diagnosis.

Further studies with the aid of the esophagoscope have demonstrated the existence of a new disease entity, a congenital short esophagus, which has been responsible for the confusing clinical and roentgenologic findings. This has been corroborated by the changes noted at biopsy and at postmortem examination.

By bearing in mind the existence of such an anomaly, one may prevent misdirected medical treatment or nonindicated surgical operation on the gastro-intestinal tract.

The treatment does not differ from the known methods applied in the care of ulceration and stricture of the esophagus.

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Clinical Notes

FATAL OTOGENIC INFECTION WITH BACILLUS PROTEUS

Report of Two Cases

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It has been only in recent years that Bacillus proteus has been regarded as having distinct pathogenic properties. Benstead and others [1] in 1929 stated that the microbe is frequently found in association with other organisms in various inflammatory conditions in man, but rarely is B. proteus the sole infecting organism and extremely rarely is it the cause of septicemia. Up to 1925 Warren and Lamb [2] were able to find in the literature only four cases of B. proteus septicemia. However, since that time there have been reported in the American and European literature an increasing number of cases in which B. proteus has played the sole etiologic rôle in infection of the ear, throat, urinary tract, meninges or blood stream.

In 1922 Kernan [3] reported two cases of fatal B. proteus infection which were of especial otolaryngologic interest. The first patient had a peritonsillar abscess, which was followed by an infected thrombosis of the jugular vein, extending to the petrosal and cavernous sinuses and the ophthalmic veins. Autopsy showed in addition purulent meningitis and abscess in the temporal lobe and the lung. B. proteus was the only organism cultured. The condition in the second case was typical of the otologic picture of this infection. Chronic suppurative otitis media was complicated by an epidural abscess, lateral sinus thrombosis and infection of the blood stream. Positive cultures were obtained from the blood stream and the epidural abscess. Stein [4] in 1930 reported three cases of infection with B. proteus. In one case the infection followed tonsillectomy; in one it followed the implantation of radium in a tonsil, and in one it was associated with secondary mastoiditis. In the first two cases the infection was fatal. Recently Smith and Miller [5] reported a case of thrombosis of the lateral sinus caused by B. proteus. Positive cultures of material from the lateral sinus and of the blood were obtained. The histories were similar—chronic otitis media was complicated by fatal sinus thrombosis and septicemia.

Elsewhere in the body B. proteus has been cultured as the sole infecting agent in cases of meningitis, infection of the urinary tract, infantile diarrhea, food poisoning, pulmonary abscess and postpartum infection. Neal and Abramson [6]

From the University of Virginia Hospital, Department of Otolaryngology.

1. Benstead, H. J., and others: A System of Bacteriology in Relation to Medicine, Medical Research Council, London, His Majesty's Stationery Office, 1929, vol. 4, p. 308.
2. Warren and Lamb: J. M. Research **44**:375, 1925.
3. Kernan, J. T., Jr.: Laryngoscope **32**:304-310 (April) 1922.
4. Stein, S.: Ann. Otol., Rhin. & Laryng. **39**:1155-1160 (Dec.) 1930.
5. Smith, A. B. P., and Miller, S.: Lancet **1**:862 (April 13) 1935.
6. Neal, J. B., and Abramson, H.: Am. J. M. Sc. **174**:665-670 (Nov.) 1927.

reviewed seven cases of B. proteus meningitis, in some of which the condition was secondary to otitis media. Kretschmer and Mason [7] found B. proteus in pure culture in eight of two hundred and twenty-four cases of infection of the urinary tract other than tuberculosis. They reported two cases of B. proteus septicemia of nephritic origin. Both patients recovered. McKenzie and Hawthorne [8] found reports of seventeen cases of B. proteus septicemia secondary to disease of the urinary tract. In five of these cases the condition proved fatal. Outbreaks of food poisoning have been attributed to B. proteus, but the evidence in favor of this organism as the sole cause is inconclusive.

B. proteus is a gram-negative motile bacillus, similar to Bacillus coli but differentiated by its liquefaction of gelatin. It is a saprophytic organism, most frequently associated with decomposing organic matter of animal origin. Its action differs from the active agents of putrefaction, the spore-forming anaerobes, in that no decomposition occurs in the absence of oxygen. Larsen and Bell [9] showed that many strains of the microbe are nonpathogenic and that few are pathogenic to man. They thought that a positive reaction of rabbits to inoculation is strong evidence that the strain is pathogenic to man. B. proteus X 19 of Weil and Felix (diagnostic agglutination in typhus) differs serologically but culturally resembles the various strains of B. proteus.

REPORT OF CASES

A patient aged 13 was admitted to the University of Virginia Hospital because of high fever (temperature 104 F.) headache, stiff neck and vomiting. Physical findings were limited to chronic suppurative otitis media on the left and considerable tenderness on pressure over the region of the emissary vein on that side. Roentgenograms showed sclerotic mastoids, with a suspicion of a haze in the petrous process on the left. The white blood cell count was 16,000, with a normal Schilling index; the Wassermann reaction was negative, and the urine and spinal fluid were clear. A radical mastoidectomy was done, and a perisinuous abscess was discovered. The sinus wall was black, foul smelling and necrotic. No evidence of thrombus was found on opening the lateral sinus.

Culture of the blood on the patient's admission gave negative results. On the following day, before the mastoidectomy was performed, a second culture was reported to contain a pure growth of B. proteus. Culture of the pus from the perisinuous abscess was reported to contain B. proteus, and another blood culture five days after operation was found to contain a pure growth of B. proteus. The spinal fluid was clear on two occasions, and the urine was reported to be essentially normal on four examinations. The white cell count varied from 12,600 to 17,000, with a gradual marked shift of the Schilling count to the left. The Gruber-Widal test and agglutination with Pasturella tularensis, B. proteus X 19 and Brucella abortus gave negative results.

On the third postoperative day signs of consolidation at the base of the left lung developed, accompanied by considerable foul-smelling sputum, which also yielded B. proteus on culture. Two blood transfusions were given. Profuse pulmonary hemorrhage marked the terminal picture. Death occurred ten days after admission.

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7. Kretschmer, H. L., and Mason, L. W.: Bacillus Proteus Septicemia: Report of Two Cases with Recovery, J. A. M. A. **92**:1734-1737 (May 25) 1929.

8. McKenzie, D. W., and Hawthorne, A. B.: J. Urology **30**:277 (Sept.) 1933.

9. Larsen, W. B., and Bell, E. T.: J. Exper. Med. **21**:629-643 (June) 1915.

Bacteriologically the organism cultured was a gram-negative, motile bacillus which digested Loeffler's mediums and formed a spreading growth on agar. Dextrose, saccharose and maltose were fermented. The subcutaneous injection of the organism into a mouse gave negative results, but intraperitoneal inoculation was fatal in six days. The organism cultured from the peritoneum and heart blood of the mouse was B. proteus. The results of tests for agglutination were reported as follows:

Patient's serum against:	1:10	1:20	1:40	1:80
Patient's organism...	3 plus	3 plus	3 plus	
Patient's organism against:				
B. proteus X 19 serum	0	0	0	0
B. proteus X 20.....	0	0	0	0
B. proteus KO.....	0	0	0	0

Postmortem examination showed septic thrombosis of the right lateral sinus, jugular bulb and petrosal sinuses; slight localized meningitis; multiple septic infarcts of the lungs, with abscess formation and empyema; purulent bronchitis, with atelectasis and compensatory emphysema; lobular pneumonia; cloudy swelling of the liver and kidneys; acute splenic tumor, and infestation with Ascaris lumbricoides.

The left lung was entirely gangrenous in appearance, with large abscess cavities communicating with the pleural cavity and the bronchi. Fresh infarcts were present in both the upper and the lower lobe.

The walls of the right venous sinuses were black and necrotic.

Case 2.—A patient aged 9 was admitted to the University of Virginia Hospital complaining of pain in the left ear of two days' duration, associated with vomiting and fever, the temperature reaching 104 F. The left ear had been draining off and on for two or three years. Examination showed the drum to be gone and the middle ear to contain a little granulation tissue. The boy was slightly disoriented and presented some tenderness over the left mastoid process. The white cell count varied from 14,000 to 21,000 during the course of his illness. The urine was clear, and lumbar puncture gave negative results except for a suggestive Tobey-Ayer reaction on the left. A simple mastoidectomy was performed, with ligation of the left jugular vein. After removal of the hard cortex a perisinuous abscess was found. The sinus wall was dirty brown. The culture of the clot removed from the lateral sinus showed a pure growth of B. proteus. One blood culture was negative. In spite of two blood transfusions the patient died nine days after admission. A note was made of the extremely offensive foul discharge from the mastoid cavity. Autopsy was not permitted.

COMMENT

Few realize that B. proteus is more than a harmless saprophyte or that it is capable of causing a variety of severe, even fatal, infections.

From an otologist's point of view the severity of this type of infection would surely indicate that in those cases of chronic otorrhea in which B. proteus has been found in pure culture radical rather than conservative methods should be tried. This is especially true if the inoculation of rabbits shows a pathogenic strain of the organism.

B. proteus is probably a secondary invader which, as a saprophytic organism, after the original infection has subsided, finds the middle ear with a chronic infec-

tion a fertile place in which to grow. Page[10] cultured material from seven hundred and forty-nine persons with acute infection of the middle ear and did not report the presence of B. proteus in a single instance.

It is difficult to explain the sudden activation of a latent B. proteus infection. The long-continued presence of a microbe should increase rather than decrease the resistance to the organism. However, the lowering of general resistance of the body by intercurrent disease or exposure or the addition of a new and virulent strain to the existing organisms may be the factors which produce a change from a local to a generalized infection.

Autogenous vaccine has been the only treatment thus far suggested, and on several occasions it has been said to be effective.

The two cases reported here are typical examples of the dangerous possibilities of a chronic B. proteus infection of the middle ear. The black necrotic sinus wall and the foul odor demonstrate the saprophytic properties of the microbe.

SUMMARY

Two cases of fatal otogenic infection due to B. proteus are reported: while this type of infection is uncommon, attention is called to the seriousness of the presence of this organism in chronically draining ears.

I am indebted to Dr. Cuthbert Tunstall for cases here reported.

10. Page, J. R.: Bacteriology of Acute Infections of the Middle Ear and Mastoid, Arch. Otolaryng. **22**:447 (Oct.) 1934.

OPERATIVE CONTROL OF PROGRESSIVE EXOPHTHALMOS

EDWARD CECIL SEWALL, M.D.,* SAN FRANCISCO

Progressive exophthalmos is a serious disorder. It is not always controlled by surgical or other therapy directed toward the thyroid. It may cause blindness from involvement of the optic nerve and the background or from ulceration of the cornea and eventual ophthalmitis. The problem presented is caused by an increase in the bulk of the orbital content beyond the capacity of the orbit itself. Naffziger and Jones[1] explained the increase in bulk and have met the problem by a decompression operation. They expressed the belief that the increase in bulk is essentially due to changes that increase the thickness of the ocular muscles to many times their natural size. Their histologic sections confirm this opinion. Their method consists of entering the skull in the frontal region, elevating the dura and

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* Assisted by the Rockefeller Fluid Research Fund.

Read at the Western Section of the American Laryngological, Rhinological and Otological Society, Inc., Del Monte, Calif., Feb. 2, 1936.

1. Naffziger, H. C.: Pathologic Changes in Orbit in Progressive Exophthalmos, with Special Reference to Alterations in Extra-Ocular Muscles and Optic Disks, Arch. Ophth. **9**:1 (Jan.) 1933. Naffziger, H. C., and Jones, O. W., Jr.: Surgical Treatment of Progressive Exophthalmos Following Thyroidectomy, J. A. M. A. **99**:638 (Aug. 20) 1932.

the frontal lobe of the brain, removing the bony roof of the orbit, avoiding the sinuses, enlarging the optic foramen, incising the orbital periosteum and the ligament of Zinn and closure of the wound. Their results have been excellent and the mortality nil. They do not recommend the procedure for cosmetic purposes. They have covered the history and the literature. Their ingenious method of gaining room for the contents of the orbit involves a region in which I have been interested and immediately suggested to me that an equal or greater amount of space about the orbit might be gained by utilizing the neighboring sinuses. It even seemed reasonable to combine with this technic removal of the dural plate of the roof of the orbit through the incision in the sinus if necessary. The infra-orbital fissure also may be controlled. This was suggested by Swift,[2] working via the Kroenlein approach.

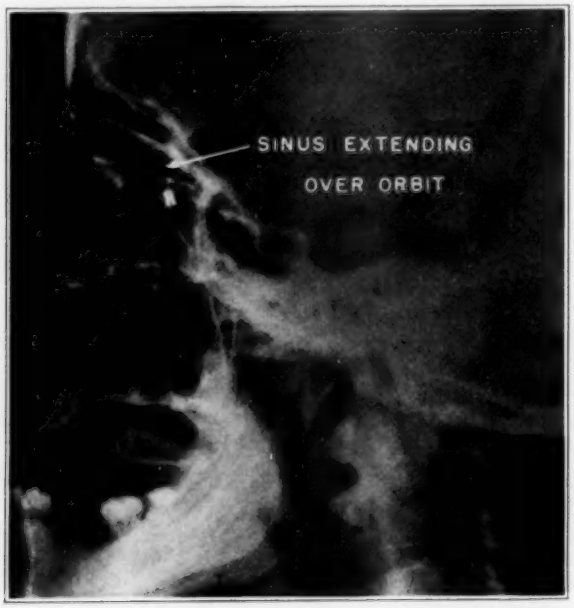

Fig. 1.—Roentgenogram showing the extent to which the roof of the orbit is covered by the frontal sinus and the ethmoid cells.

In writing on the fronto-ethmosphenoid[3] operation many years ago I called attention to the fact that after the lamina papyracea is removed the contents of the orbit crowd into the ethmoid region. The more or less complete obliteration of the frontal sinus by the upward expansion of the contents of the orbit is a fundamental principle in the operation of Killian.

2. Swift, G. W.: Operative Approach for Exophthalmos, West. J. Surg. **43**: 119 (March) 1935.

3. Sewall, E. C.: External Operation on the Ethmosphenoid Frontal Group of Sinuses Under Local Anesthesia: Technic for Removal of Part of Optic Foramen Wall for the Relief of Pressure on the Optic Nerve, Arch. Otolaryng. **4**:377 (Nov.) 1926.

Working on the problem in the laboratory, I found it possible to remove any or all of the three walls of the orbit through the usual incision used in my fronto-ethmosphenoid technic. This method appears to have several advantages over the intracranial approach. The principal one, aside from the greater ease and safety of approach, should accrue from the increased space obtained for decompression. As the intracranial approach avoids opening the sinuses, in some cases it must of necessity remove little of the orbital wall. Figures 1 and 2 show the extent to which the roof of the orbit may be covered by the frontal sinus and extensions of the ethmoid sinus. They may occupy the greater part of the roof. The extent to which this is true may be easily determined by stereoscopic roentgenograms. The disadvantage of my technic is that the sinuses have to be exenterated. That fact requires the operator to take the responsibility for their subsequent behavior. The protection of the frontonasal opening with the mucoperiosteal flap is essential.[4]

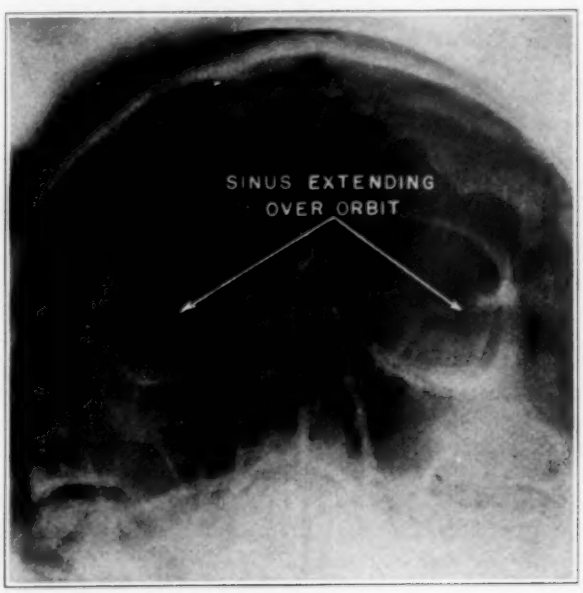

Fig. 2.—Roentgenogram showing the extent to which the frontal sinus and the ethmoid cells cover the roof of the orbit in an anteroposterior direction.

This paper does not permit a detailed description of my fronto-ethmosphenoantrum, or pansinusitis, technic. It has been described elsewhere [3] except for some recent developments, a report of which will appear shortly. The method outlined here has been worked out only in the laboratory and so far as I know has never been used for the relief of progressive severe exophthalmos. However, a maximum of space should be gained by the use of the air spaces about the orbit. The practicability of the method seems assured from the experience gained from operating in this manner for sinusitis. The inclusion of the antrum by the removal of its roof is a new feature. This would not cause disease in a normal antrum.

4. Sewall, E. C.: The Operative Treatment of Nasal Sinus Disease, Ann. Otol., Rhin. & Laryng. **44**:307 (June) 1935.

The steps in the method are briefly enumerated and follow the fronto-ethmoid technic. After administration of the usual preoperative sedatives and local block anesthesia, the regular incision through the skin of the orbit is made. The frontal and ethmoid sinuses are entered as usual, and their orbital walls are completely removed. The ethmoid cells are exenterated. The sphenoid is not interfered with unless it is diseased or unless the optic foramen requires enlargement. This feature has been described.[5] After the lamina papyracea is removed, the floor of the orbit is resected outward as far as the position of the infra-orbital artery and nerve will allow. These structures are usually placed laterally and allow removal of enough of the roof of the antrum without their injury. They may be severed if necessary. This probably will seldom be required. The roof of the orbit and of the sinus (the dural plate) may be removed by this technic.

5. Sewall, E. C.: Further Development of the Transsphenoid Approach to the Optic Foramen, Ann. Otol., Rhin. & Laryng. **37**:839 (Sept.) 1928.

A NEW PORTABLE AND UTILITY LIGHT FOR THE OTOLARYNGOLOGIST

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The lamp bracket described here was designed in the department of otolaryngology of the Cook County Hospital, where it has proved valuable. Similar devices are being utilized with satisfaction in the children's and contagious departments of the Cook County Hospital as well as in the infirmary of the Cook County Training School for Nurses.

The incentive for devising this light was created by the wholly inadequate facilities in the form of portable lights used heretofore in the examination of extradepartmental patients.

DESCRIPTION

The lamp bracket, shown in figure 1, is completely finished in chrome plating and is supplied with a 100 watt "bull's-eye bulb." Its weight is 17 ounces (482 Gm.), and it is encased in a carton 11 by 3¾ by 3½ inches (28.4 by 9.7 by 9.5 cm.), which readily fits into the practitioner's bag.

The bulb (*A*) is set in a standard light socket (push through type). The socket is controlled by a swivel joint (*B*), the function of which is to provide a ready focus of the spot light on the head mirror.

The S-shaped shank (*C*), a hollowed, bivalved casting with a ball and socket joint at each end, is maintained intact by the aid of two thumb screws. This shank facilitates the proper placing of the light bulb through the manipulation of the ball and socket joints and also aids in producing a compact article when the spring clamp (*D*) and the light socket are folded on it.

The spring clamp (*D*) is especially designed to provide a solid support on cylindrical as well as flat surfaces, such as may be found on tables, chairs or beds. Each arm is fitted with a thin metal plate for hand-gripping purposes. Rubber guards cover each jaw to prevent the marring of polished surfaces.

Figure 2 shows the device fitted with a lamp shade and serving as a reading light. Its uses are innumerable, and it is of service to the general practitioner, hospital, traveler and household, as well as to the otolaryngologist.

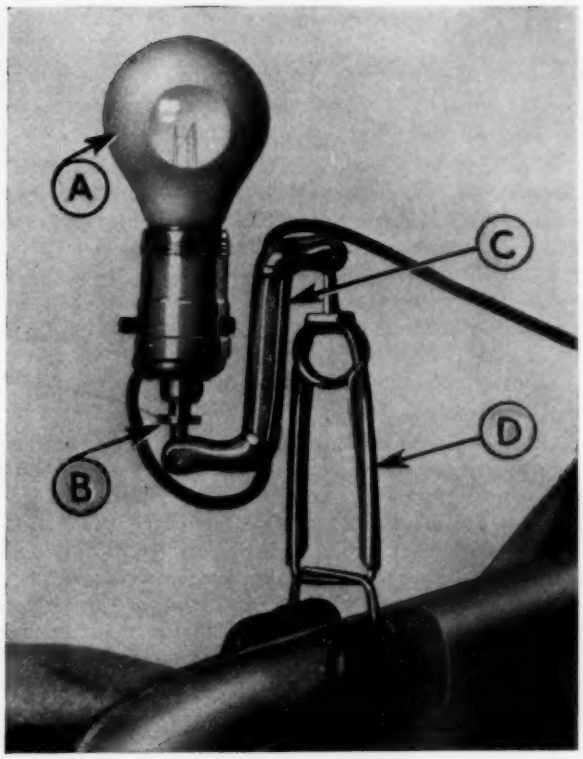

Fig. 1.—The Peluse Portable Light in detail: *A* indicates the 100 watt "bull's-eye bulb"; *B*, the swivel joint; *C*, the shank with ball and socket joints, and *D*, the spring clamp with rubber-covered jaws.

Fig. 2.—The portable light fitted with a lamp shade for use as a reading lamp by convalescent patients and by the hospital personnel and for travel purposes.

SUMMARY

The valuable features of the Peluse portable light are: (1) its compactness and portability, (2) the adaptability of the specially designed spring clamp, (3) the adjustability of the light bulb through the easy manipulation of the two ball and socket joints, (4) the ready focus of the spot light on the head mirror obtained by adjusting the swivel joint and (5) the broad utility of the light.

This lamp may be purchased from the Peluse Specialties, 105 South Jefferson Street, Chicago.

A SIXTY CYCLE FARADIC STIMULATOR

EDMUND PRINCE FOWLER JR., M.D., NEW YORK

During an operation on the mastoid, especially during a radical operation, it is a not uncommon occurrence for the operator to observe a piece of tissue which resembles nerve tissue. If this is near the path of the facial nerve the usual procedure is to ask the anesthetist to watch the face while some instrument is used to traumatize the tissue. If the tissue is the facial nerve, the trauma of pinching it will produce a twitching of the face provided the patient is under light anesthesia. Often there is a small nubbin of infected tissue near the region where the facial nerve is known to lie, and the operator removes this with considerable trepidation for fear that the facial nerve may be traumatized.

How much better it would be to apply a faradic current to all pieces of tissue about which one is in doubt and to explore with this current for exposed nerves before dangerous strokes of the curet or the rongeur are made. The old-fashioned inductoria are not reliable. The vibrator on the induction coils stops at the most crucial moments; the batteries wear out, and the current produced varies from day to day, in fact, from moment to moment. While working with Dr. Arthur B. Duel on a grant from the Carnegie Foundation of Washington, I had occasion to build an inductorium of the type presented here. The idea came from John Myers, an electrical engineer and medical student. The latter in collaboration with Dr. Marion Hines and others, under Professor Lewis, in the department of anatomy at the Johns Hopkins University, had shown that the optimum electrical stimulus for peripheral nerves as well as for the central nervous system was between 60 and 90 cycles per second. Under the direction of Myers several members of the department built small inductoria using the ordinary 60 cycle alternating house current. I built one myself from a Lionel train transformer and a voltmeter, using a radio rheostat for fine control (fig. 1). A year's experience with this rough apparatus in Dr. Duel's Laurelwood laboratory revealed its infinite superiority for the study of the peripheral nerves. Since coming to the Presbyterian Hospital, I have been using a similar apparatus made of standard radio parts for stimulation during simple and radical operations on the mastoid as well as during a few operations on the facial nerve. The instrument has proved to be

From the Department of Otolaryngology of the Columbia University, the Presbyterian Medical Center and the Laurelwood Laboratory, Dr. A. B. Duel, Director.

Read before the New York and Philadelphia combined Sections on Otolaryngology at the Academy of Medicine, New York, March 18, 1936.

very comforting during surgical intervention on the mastoid, because if a facial nerve is exposed it can always be definitely located by the use of the faradic current. The old-fashioned inductorium can, of course, be used also, and the purpose of this communication is to urge the inclusion of an electrical nerve stimulator of some sort in the armamentarium of the surgeon operating on the mastoid, so that if there is any question of the location of the facial nerve, the faradic current can be applied and the question settled without the obviously crude method now in vogue of traumatizing tissue in order to see whether it is a nerve. The main advantage of the machine shown here is that it has no battery and is therefore always available for use and, as mentioned before, a quantitative stimulus can always be obtained. The procedure used in the Presbyterian Hospital is to sterilize the electrode in 70 per cent alcohol before operation on the mastoid. In case of a question of the exact location of the nerve during the operation, the indifferent electrode is quickly attached to the leg of the patient and a

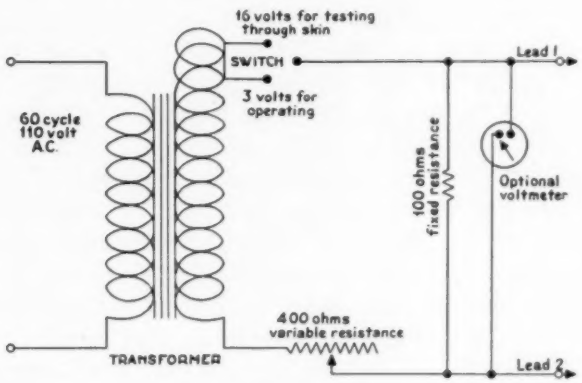

Fig. 1.—Diagram of the stimulator.

test made of the exposed temporal muscles in the wound. The minimum current which will contract the naked temporal muscle, which is always present in the upper end of a mastoid wound, is used for testing the suspected area in the mastoid cavity. If this happens to be viable facial nerve, there is always a strong contraction of the face if a powerful current is used. That is why care must be taken to use a minimum stimulus. Strong currents apparently can penetrate a thin covering of bone and stimulate the nerve beneath. It has also been found essential to dry the suspected areas carefully; otherwise fluid can conduct the current to a distant exposure of the nerve and localization of the exposure is inaccurate.

The apparatus is adjusted with two taps, one for testing during operation, supplying from 0.25 to 3 volts (the average amount is about 0.5 volt), and another for testing through the skin, supplying from 1 to 15 volts (the average current used is from 5 to 8 volts). For experimental work a voltmeter is placed across the output poles, but for ordinary work the arbitrary method of finding the minimum stimulus appears to be most satisfactory, and it materially increases the durability of the apparatus as well as reduces the cost if no voltmeter is included in the panel. A fixed resistance of 100 ohms across the output assures one that there will be relatively little difference in the stimuli as a result of

changes in the resistance of the tissues encountered. An important feature of this instrument is that it can be allowed to run for hours, so that it is not necessary to turn it on every time it is needed, as must be done with an ordinary inductorium.

In addition to its use in operation on the mastoid, this stimulator is invaluable in surgical operation on the facial nerve, whether in the mastoid, in the parotid, as in the removal of parotid tumors, or more peripherally. I think it may be of value in surgical operation involving nerves elsewhere in the body, such as emergency operations on the wrist, and in musculospiral injury.

Progress in Otolaryngology

Summaries of the Bibliographic Material Available in the Field of Otolaryngology

TONSILS AND ADENOIDS

FRENCH K. HANSEL, M.D.
ST. LOUIS

In reviewing the literature for 1934 and 1935 on the subject of the tonsils and adenoids, I selected only those papers which promote discussion and which, according to my judgment, show the advances made in this particular field of otolaryngology. Several interesting and instructive papers deal with the anatomy of the tonsils and of the peritonsillar region. The latter is especially important from the standpoint of complications. Further speculations regarding the functions of the tonsils have been advanced. Further contributions to the bacteriology and pathology of the tonsils add to the knowledge of these phases of the subject. A number of diagnostic problems with special reference to chronic tonsillitis and to diseases of the lymphatic system have also been presented. The problem of rheumatism in relation to the tonsils continues to occupy the interest of many observers. Complications and treatment have chiefly concerned the matter of peritonsillar abscess, phlegmon and jugular thrombosis, with or without sepsis.

ANATOMY AND PHYSIOLOGY

Novak [1] found that the reticular fibers branch, anastomose and ramify with no regularity of pattern throughout the tonsil with the exception of those areas in the immediate vicinity of the secondary nodule, where they assume a pattern that is constant and regular. The fibers are fairly thick and are arranged more or less parallel to one another in two or three rows. In sections stained with hematoxylin and eosin it is readily seen that the small, dark-staining lymphocytes which are packed in sharply parallel rows at the periphery of the nodule correspond in their arrangement to the concentric and parallel arrangement of the supporting fibers in this part. This arrangement does not obtain around the entire periphery in some of the nodules. Some of them show a dispersion of the fibers at one pole. It is at this point that one frequently observes minute blood vessels in cross-section just outside the nodule.

1. Novak, E. J., Jr.: The Structure of the Secondary Nodule of the Tonsil: A Preliminary Report, Arch. Otolaryng. **21**:53 (Jan.) 1935.

In one section a small vessel cut tangentially was seen to be entering the interior of the nodule. These vessels are difficult to demonstrate except by silver impregnation. The arrangement of the reticular framework within the nodule differs from that of the rest of the tonsil in that the fibers do not seem to interlace as much as they do elsewhere. Moreover, they are thin and even in serial sections are difficult to trace for any distance. The arrangement is far looser, and there are wide spaces, which in counterstained preparations are shown to be packed with various cells. The cellular content of the nodule, as shown by differential staining, consists of lymphocytes of various size and maturity. There are many reticular cells, the nuclei of which alone stand out definitely, as the cytoplasm has no limiting cell boundary but forms part of a true syncytium. Mast cells and an occasional plasma cell are found.

The occurrence of striated muscle fibers in the substance of the tonsils has always been considered extremely rare. Dreeskamp [2] examined the microscopic preparations of tonsils from 260 persons from this point of view. He discovered isolated muscle fibers in a surprisingly large number (6.9 per cent).

The muscle fibers, when present, lie in the septums between the lymphatic nodules; occasionally they lie also in the lymphatic stroma. In the latter case they are not well defined muscle fibers but only "sarcolytes," a product of degeneration of striated muscle tissue.

With the help of diagrams, Dreeskamp explains how muscle fibers may come to be included in the trabeculae of the tonsils. In the embryonic state the primitive collection of lymphoid cells is closed in on the outside by a fibrous layer; immediately outside the fibrous layer is a layer of muscle fibers. As the folding of the epithelial and lymphatic layers proceeds to form the tonsils, fibrous partitions derived from the primitive fibrous layer penetrate to support the folds. One can easily understand how an occasional muscle fiber derived from the primitive layer can be drawn in together with a fibrous partition.

By the injection of a mass of gelatin into various areas around the tonsil, Wood [3] demonstrated certain anatomic relations, particularly those pertaining to the fascial planes and to the attachment of the muscles and the tonsillar capsule. It was shown that the tonsil is easily separated from the superior constrictor muscle, that there are definite limitations of space, apparently brought about by the position of the faucial and pharyngeal muscles and the perimuscular fascia, and that

2. Dreeskamp, H.: Muscle Fibers in the Tonsils, Ztschr. f. Laryng., Rhin., Otol. **25**:273, 1934.

3. Wood, G. B.: The Peritonsillar Spaces: An Anatomic Study, Arch. Otolaryng. **20**:837 (Dec.) 1934.

as the muscles of the palate and the faucial region run mostly in a longitudinal direction, the extension of the injected material is more limited in its anteroposterior extension than in its upward or downward extension. An injection in front of the palatoglossus muscle does not extend backward; in the tonsillar fossa it extends readily upward and downward but not between the tonsil and the posterior pillar; in the posterior pillar it does not reach the tonsillar fossa but extends upward on the posterior surface of the tonsil, and finally, in the lateral pharyngeal wall it extends upward to the eustachian tube and to an unlimited extent downward but does not pass into the posterior pharyngeal wall or into the posterior faucial pillar.

A brief review of some of the more recent studies of the cervical fasciae is presented by Iglauer.[4] The surgical approaches to the various areolar spaces of the neck are described. The spaces under consideration include the retropharyngeal, the retro-esophageal, the posterior mediastinal, the parapharyngeal, the neurovascular and the submental.

An interesting and instructive paper on an anatomic and clinical study of the parapharyngeal space is presented by Hall.[5] Case reports are presented to illustrate the value of a comprehensive knowledge of the anatomy of this region.

A comprehensive study of the lymphatic drainage of the head and neck, emphasizing special structures, including the tonsils and adenoids, is presented by Looney.[6]

According to Salvadori,[7] one school holds that the tonsil is a lymphatic organ possessing a hematopoietic function and that its functions are closely related to and intimately associated with those of the spleen, thymus gland, bone marrow and lymphatic glands. Another school believes that it produces lymphocytes only as a defensive organ reacting to exogenous and endogenous stimuli. A third is of the belief that the tonsil represents a residual embryonic organ, harmful to the organism in that it serves as a portal of entrance for various infections, and that it should always be removed.

Salvadori cites Marfan's conclusion, after an exhaustive review of the literature, that the tonsils are useful organs either because of their hematopoietic function or because they serve as a front line defense against external causes of morbidity. However, when they become the

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4. Iglauer, S.: Surgical Approaches to Deep Suppuration in the Neck and Posterior Mediastinum, Arch. Otolaryng. **21**:707 (June) 1935.

5. Hall, C.: The Parapharyngeal Space: An Anatomical and Clinical Study, Ann. Otol., Rhin. & Laryng. **43**:793, 1934.

6. Looney, W. W.: Lymphatic Drainage of the Head and Neck, Emphasizing Special Structures, Ann. Otol., Rhin. & Laryng. **44**:33, 1935.

7. Salvadori, G.: Peritonsillar Function and Surgical Therapy of the Palatine Tonsils, Med. inf. **2**:45, 1933.

seat of pathologic processes, they become harmful and should be removed, as their absence is compensated for by numerous other organs with analogous functions.

Peller [8] reached certain conclusions as to the function and significance of the tonsils by making statistical comparisons on the constitution and state of the tonsils of a large number of persons. The tonsils act as an inhibitory factor in growth. They inhibit increase of weight, height and thoracic expansion. The degree of inhibition is great enough to determine statistically but not enough for casuistry. The tonsils lengthen the period and decrease the rate of growth. Inhibitory impulses are increased by hypertrophied tonsils. Chronic tonsillitis apparently has no effect on the growth-inhibitory factor. Tonsillectomy affects growth in a manner independent of the factors of time, social position and age. This is a lasting effect, which is still shown years after the tonsillectomy. The tonsils are endocrine organs, the function of which is not exhausted by or identical with that of the lymphatic system. Otherwise the surprising, even if only statistical, established and demonstrable deficiency phenomena would not be clear. Tonsillectomized girls menstruate about a year earlier than those with hyperplastic tonsils and mature earlier than the average girl. There is a frequency relation between the color of the skin and hair and tonsillar hypertrophy. Blonds under similar circumstances present hypertrophy more frequently and are tonsillectomized more frequently than brunettes and darkly pigmented persons. The tonsils are a useful factor in the photochemical defense reaction of the skin. The author concludes that future research must bring out further relationships and explain those which are described here.

Peller and Zimmermann [9] continued Peller's studies, in which were demonstrated the inhibiting influence of the tonsils on the growth in height and in weight and on the development of the thorax and the promoting influence of the tonsils on the photochemical defense reaction of the skin. In this paper they report their observations on the relation between tonsils and the mammary glands. They gained the impression that the tonsils inhibit the puberal development of the mammary glands, for girls who had undergone tonsillectomy showed an earlier development. It is assumed that the tonsils influence the maturation of the mammary glands not directly but indirectly by way of general development.

Professor Citelli [10] called the attention of the Società medico-chirurgica of Catania to the effect of adenoids on the development of

8. Peller, S.: The Problem of Tonsils, Monatschr. f. Ohrenh. **68**:417, 1934.

9. Peller, S., and Zimmermann, I.: Tonsils and Mammary Glands During Puberty, Zentralbl. f. Gynäk. **58**:1950, 1934.

10. Adenoids and the Sex Glands, Italian letter, J. A. M. A. **102**:226 (Jan. 20) 1934.

the sex glands. Some time ago he demonstrated that adenoids may provoke cellular changes in the anterior lobe of the hypophysis. At puberty these changes may provoke hormonal dysfunction, both in the male and in the female, and sometimes may provoke the adiposogenital syndrome of Fröhlich. He described, from records of cases occurring from 1917 to 1929, examples of hypophysial feminism, arrest of development of the sexual organs and frigidity, in which improvement or a cure was effected either by the removal of the adenoids or in association with hypophysial therapy. He has observed similar cases recently.

Halász [11] states that the internal secretion of the tonsil is the regional hormone of the mucosa of the upper respiratory tract. Genuine ozena, he believes, is a disease of endocrine etiology, which results from tonsillar hypofunction in persons with the organic predisposition which favors the development of ozena. He states that ozena may be cured by the subcutaneous injection of an organic preparation containing tonsillar extract and extracts from the thyroid and the thymus gland, organs in close correlation with the tonsil.

PATHOLOGY AND BACTERIOLOGY

As a result of histologic studies of chronically diseased tonsils, Müller [12] came to the conclusion that an increased new epithelial growth develops on the old epithelium which is destroyed in various ways. This new growth is not confined to circumscribed epithelial thickening but involves a widening of the epithelium in the lymph passages and lymphatic tissues. Accompanying this is a new formation of fossae, with progressive cleavage of the tonsils. The undesired results are the difficult self-cleansing of the tonsils of the decaying products and inflammatory exudate and the easier and deeper penetration of tissue-damaging foreign bodies and bacteria, with the uninhibited formation of bacterial growths and conglomerations. With the appearance of a new inflammation or a new exacerbation of the injury to the tissue, the depicted process begins anew in a vicious circle, which is often broken only after years or after final operative removal of the tonsils. The clinical and the anatomic picture only rarely agree completely.

Krompecher and Nemai [13] state that epithelial cells may exhibit fatty degeneration in the lacunae of the tonsils. Histologic examination with especial attention to the results of fat-staining showed that the epithelium in the depth of tonsillar lacunae acts similarly to the epi-

11. Halász, G.: Ozena and the Tonsils, Monatschr. f. Ohrenh. **67**:1176, 1933.

12. Müller, H.: Chronic Tonsillitis, Ztschr. f. Laryng., Rhin., Otol. **25**:195, 1934.

13. Krompecher, S., and Nemai, J.: Fatty Degeneration of Epithelial Cells in Tonsillar Crypts, Monatschr. f. Ohrenh. **68**:641, 1935.

thelium in the preputial sac. The surface of the tonsils facing the oral cavity is covered with thick, nonkeratinized stratified pavement epithelium, which also has as a basis a firm layer of connective tissue. The epithelium of the walls of the lacunae is considerably thin; the margin of the connective tissue is missing; the follicles come straight up to the surface; the epithelial layer is invaded by lymphocytes, and if the fossa is deep and cut off from the air (favorable average condition similar to that in the depth of the sebaceous gland), the epithelium shows fatty degeneration. This observation permits a contribution to the knowledge of fatty stratified pavement epithelium. Macrophages infiltrated by accumulations of fat were found regularly in the parenchyma, in the epithelium and also in the content of the fossa (detritus). The physiologic detritus in the tonsillar fossa is built up from exfoliated epithelial layers which undergo fatty degeneration and from accumulations of lymphocytes. There are also to be found a number of leukocytes, plasma cells, macrophages and bacteria. Occasionally the condition results in the formation of a concrement.

An investigation of the microscopic histopathologic picture of the palatine tonsil by Smith[14] concerns, first, the more common pathologic conditions and, second, a correlation between the clinical history which resulted in tonsillectomy and the actual microscopic diagnosis after examination of specimens from 104 routine tonsillectomies. Smith used the following five guides in establishing the diagnosis of various degrees of tonsillar infection: 1. The amount of cellular elements and débris in the crypts. Emphasis was placed on the great importance of the presence of plugged crypts and of crypts which seem to have inadequate drainage. 2. The intactness of the epithelium. In severe inflammation the epithelium is usually desquamated, the amount of desquamation depending on the severity of the reaction. 3. Chronic infection is accompanied by fibrosis; hence the amount of this change throughout the tonsillar stroma is taken into consideration. 4. The amount of congestion of the blood vessels and the presence of many vessels. 5. The condition of the germinal centers, taking into consideration the age of the patient, the centers being large, numerous and active in children, gradually fading out of the picture as the patient grows older. Abnormalities of size and number are also taken into consideration.

Of 30 suspicious tonsils examined microscopically, 20, or 66.66 per cent, showed merely chronic inflammation. Epithelial carcinoma of all grades occurred in 13.33 per cent of all the tonsils, and lymphoblastoma was found in 6.66 per cent. Tuberculosis was present in only 1 tonsil, or 3.33 per cent. Papilloma likewise appeared in only 1 tonsil. Among

14. Smith, H. D.: Microscopic Pathology of the Palatine Tonsil, Arch. Otolaryng. **21**:426 (April) 1935.

2,200 tonsillectomies performed at the Massachusetts Eye and Ear Infirmary, only 4, or 0.18 per cent, of the tonsils were carcinomatous. In 2, or 0.09 per cent, there was lymphoblastoma, and in 1 each, or 0.045 per cent, there was tuberculosis and papilloma. In a group of 104 routine tonsillectomies an attempt was made to correlate the clinical history and the microscopic diagnosis. The largest group of patients, 45, or 43.26 per cent, complained of recurrent sore throat and colds. Of this number 39, or 86.66 per cent, showed chronic tonsillar infection; the remainder were normal. In 17 patients, or 16.34 per cent, tonsillectomy was done on account of discharging ears. In 58.85 per cent the tonsils showed evidence of infection. Of 8 patients complaining of nasal obstruction, there was tonsillary infection in 62.5 per cent. Of 8 patients for whom no clinical history was given, the incidence of infection was 62.5 per cent. Of a small group of patients who were considered from the standpoint of foci of infection in the presence of iritis, arthritis, etc., which constituted 6.71 per cent of the total number, 85.71 per cent showed infection of the tonsils.

The incidence of carcinomatous, tuberculous and other grave pathologic conditions was found to be small, these conditions occurring in about 0.4 per cent of the total number of patients who undergo routine tonsillectomy.

Jason [15] made an investigation of the relationship of pathologic changes in the tonsils to the clinical causes for tonsillectomy. From these studies he concludes that in the tonsils removed as a routine there is little evidence of the transformation of lymphocytes into macrophages. Repair in tonsillar disease occurs as an ingrowth of granulation tissue from the capsule, trabeculae or marginal subepithelial connective tissue and not by the focal transformation of lymphocytes about the crypts. It was further pointed out that in general the patients with local complaints and physical signs of tonsillar disease have relatively fewer pathologic changes in their tonsils than those with systemic disease or changes elsewhere in the body attributable to the tonsils. Young adults may show as marked tonsillar enlargement as children, in whom enlarged lymphoid structures are common.

In 12 cases of malignant disease of the nasopharynx, tonsils and pharynx studied by Cappell [16] the condition was believed to be of epithelial origin, arising from the specialized epithelium of the pharyngeal lymphoid tissues. The value of silver impregnation of the reticulum as a means of demonstrating the structure of such growths is empha-

15. Jason, R. S.: Pathologic Changes in the Human Palatine Tonsil: Their Correlation with the Clinical Findings, Arch. Otolaryng. **19**:600 (May) 1934.

16. Cappell, D. F.: On Lympho-Epithelioma of the Nasopharynx and Tonsils, J. Path. & Bact. **39**:49, 1934.

sized. These tumors show distinctive clinical and pathologic features and may justifiably be separated from other neoplasms under the name "lympho-epithelioma." Two main types of histologic structure have been recognized, one corresponding to the classic lympho-epithelioma of Regaud and the other to the lympho-epithelioma of Schmincke. It was shown that these are not different types of neoplasm but represent merely quantitative differences in the mode of growth and the spread of the tumor cells. Evidence for regarding transitional cell carcinoma of the nasopharynx and the tonsil as a different form of neoplasm from lympho-epithelioma was not definitely established in the present observations, and it is believed that the two are at least closely related. Lympho-epithelioma is highly sensitive to roentgen rays, and the value of roentgen therapy in contrast to surgical excision is clearly demonstrated in the present series of cases.

Schlittler [17] relates that in 98 instances of cervical lymphoma, in which the condition was suspected to be of a tuberculous character but in which pulmonary tuberculosis or tuberculosis of other organs could be excluded, the tonsils were removed and their examination revealed tuberculosis in 48 cases. Thus, it appears that in case of prolonged lymphadenitis of the neck, particularly at the angle of the jaw, primary tuberculous disease of the corresponding tonsil may be suspected, especially when in the region of the upper air and food passages there are no other causes detectable which would explain the swelling of the lymph nodes and when the examination of the lung likewise gives negative results. In addition to the subacute or chronic form of lymphadenitis, there is also one in which an acute swelling of the cervical lymph nodes at the angle of the jaw becomes manifest with the symptoms of acute tonsillitis or peritonsillitis. However, the stationary behavior differentiates it from the swelling of lymph nodes caused by other infections. He thinks that primary tuberculosis of the tonsils is not so rare. There is generally no macroscopic change in the tonsil, and only microscopic examination permits a diagnosis. It is nevertheless advisable to remove the primary focus, the tonsils, for this measure would prevent further invasion of tubercle bacilli from the tonsils into the cervical lymph nodes and thus would lead to a more rapid cure of the tuberculosis of the cervical glands. The tonsils of these patients should always be subjected to microscopic examination in order to gain a better insight into the interrelation between primary tonsillar tuberculosis, tuberculosis of the lymph nodes and tuberculosis of the lungs. Physical and roentgenologic examination of the lungs should also be made.

17. Schlittler, E.: Significance of the Tonsils as a Port of Entry in Tuberculosis, Schweiz. med. Wchnschr. **64**:594, 1934.

A review of the cases of primary tonsillar tuberculosis in which the diagnosis was confirmed by necropsy shows that a swelling of the lymph nodes draining the tonsils occurs in the neighborhood of the angle of the jaw. Schlittler [18] reports that in 98 cases in which the patient had chronic or subacute lymphadenitis at the angle of the jaw definite microscopic tuberculosis was demonstrated in the removed tonsils 48 times. Primary tonsillar tuberculosis is therefore the diagnosis of choice in the presence of this type of adenopathy. In these 48 cases of histologically proved tonsillar tuberculosis, a pharyngeal tonsil was the seat of the lesion 7 times, a pharyngeal and a palatine tonsil 6 times, both palatine tonsils 7 times and one palatine tonsil 28 times. Several features of the condition in these 48 cases speak for the primary involvement of the tonsil: the absence of open pulmonary tuberculosis or tuberculosis of other organs, the further behavior of the patients after removal of the tonsils, the strict localization of enlarged lymph nodes to the region draining the tonsils and, finally, the relative frequency of involvement of only one tonsil (73 per cent). The author believes that in the rest of the 98 cases, in which no tuberculous changes were found in the tonsils, the primary factor might still be tuberculous but the condition had healed to such an extent that the original lesion was not found. He finds evidence for this view in the decreasing number of cases of this type in which he and his associates are unable to find tuberculosis of the tonsil after removal.

Bits of tonsillar tissue of 139 syphilitic patients were removed, macerated and examined under dark field illumination by Kumasawa.[19] Three of the 13 specimens from patients with primary syphilis and 18 of the 27 from those with secondary syphilis (all the nontreated patients in this group) contained Spirochaeta pallida. In patients with the later stages of the disease the results of examination were positive at times even when the Wassermann reaction was negative. When the tonsil was reddened and swollen, spirochetes could at times be demonstrated in the scrapings from the surface of the tonsil even though the inflammation was not specific.

Although the tonsils are commonly involved in the secondary stages of syphilis, Pund and Brawner [20] found on reviewing the literature that the opportunity for histologic study of this condition is rare. They

18. Schlittler, E.: Subacute and Chronic Cervical Lymphadenitis as a Diagnostic Sign of Primary Tonsillar Tuberculosis, Ztschr. f. Hals-, Nasen- u. Ohrenh. **35**:400, 1934.

19. Kumasawa, M.: Tonsillar Studies on Syphilitic Patients, Hifu-to-Hitsunyo **2**:451, 1934.

20. Pund, E. R., and Brawner, G. H.: Syphilitic Tonsillitis: Histopathology in the Secondary Stage, Ann. Otol., Rhin. & Laryng. **44**:984, 1935.

report 2 cases and describe the histopathologic observations. Tonsillitis of this type is characterized by a diffuse reaction in the lymphatic stroma manifested by a diffuse fibroblastic and angioblastic proliferation with large mononuclear cells. Fibroblasts and new-grown capillaries may replace much of the lymphoid tissue. Accompanying this diffuse reaction, foci of epithelioid cells may be observed in the vicinity of the epithelium-lined crypts.

An article by Pellegrini [21] on systemic researches on the presence of osseous and cartilaginous tissue in the palatine tonsils contains a good review of the literature. The conclusions drawn are from a meticulous histologic examination of 432 tonsils. These types of tissue are present more frequently in older persons. In the new-born and in children, the cartilage must be considered to be of embryonic origin, probably from wandering germs of the second branchial arch. The cartilaginous inclusion found in the adults originates from metaplasia of the connective tissue as a result of chronic inflammatory stimulation. The osseous tissue is never found in the tonsils of persons under 15. Being of inflammatory origin, it may arise directly from connective or cartilaginous tissue. Seventeen interesting photomicrographs accompany the article.

Seydell [22] reports an interesting case in which tissue from the parotid gland was found in the tonsillar fossa. After removal of the tonsils, a small growth was noted in the region of the lower pole of the right tonsil. The excised portion was yellowish and soft and seemed to have no relation to the tonsil itself. Microscopic examination of this specimen showed that it consisted of tissue from the parotid gland.

A histologic study of the lesions of rheumatic fever was undertaken by Sarafoff,[23] who made serial sections of the tissues of the organs of the neck. The tonsils and adenoids failed to reveal any changes typical of rheumatic disease, in contradistinction to peritonsillar tissue, which was markedly involved in 4 of the 7 cases. No conclusions could be drawn as to the special portal of entry of the rheumatic virus, since the lesions showed various distribution in the different cases. There is no evidence which would indicate that the tonsillar tissue is the sole portal of entry, since signs of nonspecific inflammation were found in the mucous membranes of the pharynx and the larynx.

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21. Pellegrini, G.: Systemic Researches on the Presence of Osseous and Cartilaginous Tissue in the Palatine Tonsils, Arch. ital. di otol. **45**:180, 1934.

22. Seydell, E. M.: Parotid Gland Tissue in the Tonsillar Fossa, Ann. Otol., Rhin. & Laryng. **43**:304, 1934.

23. Sarafoff, D.: The Histologic Picture of Rheumatic Fever: X. The Upper Air and Food Passages in Rheumatism, Virchows Arch. f. path. Anat. **286**:314, 1932.

In similar studies Klinge [24] made serial sections of the tonsils of 2 patients who suffered from attacks of acute rheumatic fever three weeks and five months, respectively, previous to the removal of the tonsils. They revealed rheumatic inflammation in the peritonsillar tissue in various stages of development, as described in previous papers. In a third patient, whose first attack of rheumatic fever occurred two months previous to tonsillectomy, a few small foci were found in the peritonsillar tissues. In 5 other patients, who gave a similar history, no specific rheumatic changes in the peritonsillar tissues could be detected.

Guiffrida,[25] in a long and interesting article, reviews the literature extensively in respect to the bacteria in peritonsillar phlegmon and the pathologic variations as to age, seasonal predomination and frequency of renal involvement. He further draws the following conclusions from 121 cases of peritonsillar phlegmon studied in his clinics during the years 1931 and 1932.

Types of Bacteria: pure diplococci (gram-positive), identified as pneumococci, 25 per cent; pure streptococci, 23 per cent; pure staphylococci, 1 per cent; mixed diplococci and bacilli (mostly Bacillus coli), 33 per cent; mixed diplococci and streptococci, 11 per cent; mixed diplococci and staphylococci, 4 per cent; fusospirilla of Vincent, 2.5 per cent.

In adults the phlegmon invariably forms an abscess, while in children, if treated with moist heat, it will absorb. In certain types of persons, especially those with uremia, when the phlegmon is incised blood is obtained instead of pus. The septic type is produced by a pure streptococcic infection, which brings about systemic complications (pyemia, metastasis, endocranial complications and hemorrhage by erosion of the walls of the blood vessels).

The epidemic manifestation of this malady occurring during certain periods of the year (December and January, and June and July) seems to be caused by the thermal and climatic variations and not by a certain type of bacteria.

Parenchymatous nephritis is found only in persons predisposed to it; in all, 2 per cent. Transitory albuminuria was observed in 37 per cent of the cases; of these, 20 per cent were infected by streptococci and 13 per cent by pneumococci.

Wirth and Brander [26] investigated the frequency and clinical significance of the types of pneumococci isolated from 218 pairs of opera-

24. Klinge, F.: The Histologic Picture of Rheumatic Fever: XI. Findings in Tonsil Removed by Operation, Virchows Arch. f. path. Anat. **286**:333, 1932.

25. Guiffrida, E.: Etiopathogenic Consideration of Peritonsillar Phlegmon, Arch. ital. di otol. **44**:449, 1933.

26. Wirth, E., and Brander, E.: Pneumococcus Types in the Throat, Ztschr. f. Hals-, Nasen- u. Ohrenh. **35**:352, 1934.

tively removed tonsils. Immediately after the removal a small piece was cut out from the capsule side, washed in physiologic solution of sodium chloride, cut into small pieces with sterile instruments and mixed with physiologic solution of sodium chloride in a Petri dish. From the smaller pieces sedimenting in the dish, blood agar plates were streaked and white mice were inoculated intraperitoneally. The typing was done according to the method of Park. Pneumococci were found in 63.5 per cent of the hypertrophic pharyngeal and palatine tonsils and in about 13 per cent of the palatine tonsils removed because of chronic recurrent tonsillitis. All the pneumococci from the tonsils could be typed. Types I and II occurred only rarely. In 15.1 per cent of the hypertrophic tonsils pneumococci of type III were found, and in 42.8 per cent, pneumococci of group X. The individual types of group X varied considerably in frequency and in virulence for mice. Types VI, VIII and XIX predominated. Pneumococci were found most frequently in the tonsils of children under 10 years. With increasing age the incidence of the organism decreased. It was impossible to establish any unquestionable connection between certain types of pneumococci in the tonsils and clinical observations. Pneumococci appear to be without significance in acute postoperative and pseudomembraneous angina as well as in chronic recurrent palatine tonsillitis. Hemolytic streptococci play a much larger part. In general, the pneumococci found in these cases may be considered to play a saprophytic rôle, though under certain circumstances they can become dangerous.

Twenty-five consecutive cases in which a clinical diagnosis of chronic tonsillitis had been given were studied from the clinical, bacteriologic and pathologic standpoint by Hunnicutt, Sternstein and MacMahon.[27] It was shown that from the clinical aspect, a single change or group of changes was not found in all the tonsils and the clinical findings did not bear a constant relationship to the clinical history. From the bacteriologic standpoint, one type of flora was not observed consistently in the tonsils, nor was any characteristic type of flora found showing a relationship either to the gross appearance of the tonsil or to the clinical signs and symptoms. The changes in the tonsils from the pathologic standpoint, though variable, were strikingly similar to those in a group of selected controls. The histologic changes, with the rare exception of the specific lesion of rheumatic fever, did not bear a definite relationship to the bacterial flora or to the clinical signs or symptoms.

27. Hunnicutt, T. N., Jr.; Sternstein, H. J., and MacMahon, H. E.: Chronic Tonsillitis in the Adult: A Clinical, Bacteriologic and Pathologic Study, Arch. Otolaryng. **22**:744 (Dec.) 1935.

In the limited number of cases studied by Kereszturi and Park,[28] tonsillectomy had no marked effect on susceptibility to scarlet fever within six months after it had been done, as demonstrated by the changing of a positive reaction to the Dick test into a negative one.

A Schick test was performed on 232 rural children by Buice.[29] Of the tonsillectomized subjects, 68 (62 per cent) gave positive reactions. Of those with the tonsils intact, 84 (69 per cent) gave positive reactions. The proportion of positive Schick reactions among both the tonsillectomized and the nontonsillectomized children remained practically on a level through all the age groups. The children, without regard to the factor of tonsillectomy, did not appear to be acquiring immunity to diphtheria as they grew older, which is in contrast with the findings of Zingher and other investigators working among children in large cities.

Von Zsindely [30] made a comparative study of several thousand cases of scarlet fever and diphtheria which occurred before and after tonsillectomy. He found that in most cases tonsillectomy decreases the incidence of infection from both diseases. This decreased incidence after tonsillectomy seems, however, to decline parallel with the time which elapsed after operation.

Von Zsindely [31] examined cultures from the noses and throats of 1,115 school children for diphtheria bacilli. The percentage of carriers was higher among the boys than among the girls (7 per cent and 5.1 per cent, respectively). Developmental anomalies, such as enlarged tonsils, adenoid vegetations or narrow nasal passages, appeared to offer favorable mediums for the persistence of bacteria. The presence of carriers with virulent organisms did not invariably lead to an outbreak of diphtheria in the neighborhood of carriers of avirulent organisms. Carriers in schools in all probability transmit the organisms to their neighbors, who may also become carriers.

A group of aberrant diphtheria-like organisms were isolated by Barratt.[32] Although resembling Corynebacterium diphtheriae, they differ from it in certain cultural characteristics, most notably in their

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28. Kereszturi, C., and Park, W. H.: Effect of Tonsillectomy on the Development of Immunity to Scarlet Fever as Shown by the Dick Test, J. A. M. A. **101**:764 (Sept. 2) 1933.

29. Buice, W. A.: Effects of Tonsillectomy on Antitoxic Immunity to Diphtheria in a Rural Population, Lancet **1**:790, 1934.

30. von Zsindely, A.: Influence of Tonsillar Enucleation on Subsequent Scarlet Fever and Diphtheria, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **138**:195, 1934.

31. von Zsindely, A.: Diphtheria Carriers in School, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **137**:215, 1933.

32. Barratt, M. M.: Diphtheria-Like Organisms from Nasopharynx, J. Path. & Bact. **36**:369, 1933.

capacity to liquefy gelatin. The lesions produced by intradermal injection into guinea-pigs are more papular and pustular than those following the injection of typical C. diphtheriae. Diphtheria antitoxin does not prevent these cutaneous lesions, and even in large doses it does not save the life of the animal if more than one or two minimal lethal doses are given subcutaneously or with some strains even if only one is given. These aberrant strains differ further from C. diphtheriae in being pathogenic for rats by peritoneal inoculation. These studies point out that strains of this type may play a part in the causation of infection which does not respond favorably to antitoxin.

Since 1925 Brooks [33] has noted the occurrence of 1,800 cases of milk-borne septic sore throat in ten outbreaks recorded in the state of New York. In most cases these were traced to bovine mastitis. The streptococcus causing the mastitis that ordinarily occurs in cattle is not usually harmful to man, but when injured udders become infected with the organism from man mastitis becomes responsible for epidemics. Most cases occur among adults, and deaths occur mostly among persons past middle age. The only practical safeguard is pasteurization. Ordinarily there is little difference between the appearance of the throat in this condition and that in scarlet fever.

Schlesinger and Signy [34] found that streptococcic precipitins can be demonstrated in the blood of rheumatic patients following acute streptococcic infections of the throat. Their formation is delayed until from the second to the fourth week after the onset of the nasopharyngeal infection (the end of the silent period), and their appearance in most cases foreshadows an attack of acute rheumatism. The precipitin corresponds to the type of streptococcus responsible for the infection, but a certain amount of cross formation of precipitin may occur. The formation of precipitin is regarded as one of the manifold reactions which take place in the patient's defense mechanism during the silent period. Time is thus available for prophylactic measures if the infection of the throat has not passed unnoticed. Concentrated acetylsalicylic acid therapy during this period undoubtedly prevents serious relapse in many cases. It is not infallible, however, and further researches for a more reliable method are urgently required.

Wein [35] describes the case of a girl aged 18 with infected tonsils and signs of renal irritation. He first removed a small retention cyst

33. Brooks, P. A.: Epidemiology of Septic Sore Throat, New York State J. Med. **32**:1348, 1932.

34. Schlesinger, G., and Signy, A. G.: Precipitin Reactions in the Blood of Rheumatic Patients Following Acute Throat Infections, Quart. J. Med. **2**:255, 1933.

35. Wein, Z.: Ehrlich's Negative Phase as a Contraindication for Tonsillectomy, Monatschr. f. Ohrenh. **68**:52, 1934.

from the upper pole of the left tonsil. Healing of the wound occurred without any untoward event, and a week later he performed a tonsillectomy. Four days after the operation, fever, leukocytosis and other signs of sepsis developed. Short chain streptococci were isolated from the blood in pure culture. The patient died eleven days after the tonsillectomy. Wein feels that this unfortunate event was probably due to the stimulation of the antibody-producing cells by the operation on the retention cyst. For a time after such stimulation, the power to produce antibodies is lowered. This period of poor antibody production was called by Ehrlich the negative phase. It can be recognized by the fall in Wright's opsonic index. Practically, then, to avoid this phase, at least three weeks should elapse between any nasal or pharyngeal operative procedure and tonsillectomy.

An attempt was made by Bürgers and Wolfheim [36] to associate pathogenic bacteria obtained from the tonsils with the pathologic processes in those structures. Use was made of the percentile index (Fresszahl), or the proportion of leukocytes taking part in phagocytosis. It was found that in infection of the tonsils the index is low, suggesting low defensive powers, and that after tonsillectomy the index rises to 50 per cent or more. In cases in which the index was originally around 50 per cent, the authors believe that the tonsils cannot be incriminated or that the defensive mechanism is sufficient to take care of the infection without surgical intervention; further observation is called for, however, because this relationship could readily change.

Krauspe [37] presents experimental and clinical evidence to indicate that the tonsils may be involved by way of the blood stream and that the resulting involvement is often not to be readily distinguished from that which occurs by way of the exposed surface of the tonsil. Histologic examinations of sections of the tonsils and adenoids of 11 children and 14 adults who died of a variety of acute infectious diseases were undertaken. The tonsils of 25 children whose death was not due to acute infection were also examined but somewhat less thoroughly. In most of the cases of infection, especially in children, the tonsils revealed inflammatory reactions, which were interpreted as a result of hematogenous localization. Necrosis and abscesses were frequently observed, and bacteria could usually be demonstrated in the lesions. Streptococci were the most important invading organisms in children. In both children and adults localization of bacteria in the subepithelial capillaries led to inflammatory foci not to be distinguished from primary infections of

36. Bürgers, R. J., and Wolfheim, W.: The Problem of the Tonsils, Klin. Wchnschr. **10**:1064, 1931.

37. Krauspe, C.: Hematogenous Infection of the Tonsils, Virchows Arch. f. path. Anat. **287**:139, 1932.

the crypt. Involvement of the tonsils was noted in 1 case of typhoid and in 1 of bacterial glomerulonephritis.

In 16 cases of general septic infection Kolbe [38] was able only once to demonstrate hematogenous metastases in both tonsils. The tonsils do not exhibit hematogenous metastases more frequently than other organs; on the contrary, they seem to possess a certain immunity. The bacterial flora of the tonsillar crypts remains uninfluenced in septicemia unless the mouth or the pharynx is flooded with the septic bacteria through purulent metastases. The investigations show the necessity of differentiating sharply between a resorptive tonsillar disease and hematogenic metastases.

In discussing the matter of "why otolaryngologists fail to remove the focus of infection" Meyer Solis-Cohen [39] states that normal-appearing tonsillar fossae may harbor the same infecting organisms that were present in the extirpated tonsils and thus may act as bacterial foci of infection. In half the throats of which he made selective cultures to determine the pathogenic organism, both before and after tonsillectomy —in several cases after an interval of five years—the chief infecting germ was the same in both cultures. He discusses at great length the immunologic principles concerning infections of the upper respiratory tract and the results obtained by the use of vaccines.

GENERAL CONSIDERATIONS AND DIAGNOSIS

According to Dean,[40] a study of the tonsil problem requires a consideration of the lymphoid tissues of the pharynx. He believes that the tonsils in infancy and early childhood are part of the defense mechanism of the body; consequently they should not be removed before 2 years of age. The operation is always more serious in infancy than later, although adenoids which block the nasopharynx may be removed at any time. He further states that the tonsil plays a much more important part as a source of infection in children than in adults. Removal is indicated when there is infection of neighboring structures, such as the middle ear, the nasal sinuses and the glands of the neck.

According to Mitchell,[41] opinion has changed within the past few years as to the status of the tonsils and adenoids. Only a few years ago he heard a prominent colleague state that the only good tonsil is

38. Kolbe, H.: The Tonsils in Septicemia, Ztschr. f. Hals-, Nasen- u. Ohrenh. **35**:61, 1933.

39. Solis-Cohen, M.: Why Otolaryngologists Frequently Fail to Remove a Focus of Infection, Ann. Otol., Rhin. & Laryng. **43**:586, 1934.

40. Dean, L. W.: The Tonsils: Their Functions and Indications for Their Removal, J. A. M. A. **103**:1044 (Oct. 6) 1934.

41. Mitchell, E. C.: The Pediatric View of Otolaryngology, J. A. M. A. **105**: 1016 (Sept. 28) 1935.

the tonsil in a bottle. Since then that opinion has been retracted. Twice within the last year he has heard Dean express the belief that the tonsil has a function, which possibly is to act in some manner not yet demonstrated as a barrier against infection. The life cycle of the tonsil supports this concept of function in that the adenoid or pharyngeal tonsil is most active in the infant, as evidenced by its hypertrophy during this period. Later the faucial tonsil takes over the burden and is most hypertrophied during the period of childhood. The lingual tonsil plays a minor rôle until adult life. The fact that first the pharyngeal and later the faucial tonsil atrophies in the normal child is also significant.

If the tonsil has the suggested function, its removal when healthy in the young child is contraindicated. It has been the experience of Shea and Mitchell that paranasal sinusitis is much more frequent and more severe in the child who has been tonsillectomized early in life.

Mitchell cites a statement by Dean that the removal of the tonsil should be decided by a history of repeated attacks of tonsillitis or based on definite evidence that the tonsil is acting as a focus of infection; that hypertrophied tonsils and adenoids should be removed only when they obstruct breathing. A thorough physical examination should be made, including determination of clotting time, estimation of the red blood cells and hemoglobin and urinalysis. Many bad results will be avoided by this routine. No child should be operated on who shows any evidence of acute infection, whose clotting time is not normal or who evidences any degree of severe secondary anemia. It has been the practice of Mitchell in recent years to give a fresh blood transfusion before operating on a child whose hemoglobin is 65 per cent or less and in whom the indications are that not sufficient time can be allowed to build up the condition of the blood by other means. He has followed the same procedure prior to operating on chronically infected mastoids of patients who exhibit anemia.

According to Nadoleczny,[42] simple enlargement of the tonsils requires tonsillectomy only when there are respiratory disturbances and changes in the voice. Suppurative infections of the tonsils are frequent in childhood and are usually harmless. These may occur two or three times a year but are not an indication for tonsillectomy. If the infection becomes chronic, the tonsils should be removed. Peritonsillar abscess is not always an indication for surgical intervention. Acute septic infections require immediate tonsillectomy. In chronic septic infections, the value of tonsillectomy is questionable. In acute articular rheumatism preceded by angina, tonsillectomy is often beneficial, although recurrence may occur following pharyngitis. In muscular rheumatism, neuralgia

42. Nadoleczny, M.: Surgical Treatment of the Tonsils in Childhood, München. med. Wchnschr. **80**:1124, 1933.

and neuritis the effect is questionable. Acute glomerular nephritis, embolic focal nephritis (without nephrosclerosis), polyarthritis, endocarditis, glandular fever and conditions found in carriers of diphtheria bacilli are frequently improved after tonsillectomy. In chorea, chronic nephritis, severe endocarditis and myocarditis the operation has no effect. Removal of the tonsils does not protect against diphtheria or Vincent's angina. Nadoleczny advises careful examination, with rhinoscopic study of all patients.

Susin [43] summarizes the various theories concerning the function of the tonsils and discusses the disparity in reported results of tonsillectomy. He concludes that a conservative attitude should be taken toward tonsillectomy and that even in cases of acute and chronic tonsillitis partial removal is preferable to complete extirpation. A good bibliography of the Italian literature on this subject is listed.

Richter [44] presents two patients, aged 13 and 21, respectively, showing constant lymphocytosis, with a normal or slightly subnormal total number of leukocytes. The first indication for an examination of the blood in each case was acute inflammatory pharyngitis accompanied by swelling of many lymph nodes. The first case was one of acute pharyngitis; the second, one of gangrenous angina. In both cases the lymphocytosis was still demonstrable after complete recovery. In close relatives of the patients, the general state of the blood was characterized by lymphocytosis. Richter concludes that the tendency to lymphocytosis is familial and hence constitutional. He attributes a secondary rôle to the infection.

A case of carcinoma of the tonsils is reported by Dowling and Dwyer,[45] who also review the literature on this subject. They conclude that carcinoma of the tonsil is not a rare condition and is malignant in the majority of cases. In about 41 per cent of the cases reported there were no demonstrable metastases. All authors agree that radium and roentgen therapy give by far the best results in selected cases. These cases taken as a group present a bad prognosis.

Schall [46] presents an interesting report based on a statistical study of 230 cases of carcinoma of the tonsil. This group was analyzed from the standpoint of nativity, occupation, sex, marital status, age, weight, loss of weight, family history, use of tobacco, type of lesion, symptoms and duration, glandular involvement, pretreatment complications, histo-

43. Susin, G. M.: The Tonsil Problem, Prat. pediat. **11**:323, 1933

44. Richter, H.: Familial Lymphocytosis, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **138**:172, 1934.

45. Dowling, J. T., and Dwyer, M. F.: Carcinoma of the Tonsils: Case Report, Ann. Otol., Rhin. & Laryng. **43**:615, 1934.

46. Schall, L. A.: Carcinoma of the Tonsil: A Statistical Study of Two Hundred and Thirty Cases, Ann. Otol., Rhin. & Laryng. **43**:1047, 1934.

pathologic structure of the tumors and, finally, the treatment and the results obtained. From these studies Schall concludes that in certain selected cases surgical intervention may still have a place in the treatment of malignant disease of the tonsil. When the lesion has spread beyond the tonsil, however, the combined use of implantation of radium and external irradiation gives the most encouraging results.

An interesting case of metastatic hypernephroma of the tonsil is reported by Menger and Arons.[47] In 1932 a man aged 65 underwent nephrectomy for a hypernephroma on the left side. At the time it was noted that the growth might have penetrated the endothelium of the vein, and a memorandum was entered that the patient should be kept under careful observation for metastases, especially pulmonary.

In 1934 he complained of a recurrent "sore throat" following the extraction of teeth under local anesthesia three weeks previously. On the right tonsil there was an ulcerated area with a membrane suggestive of Vincent's angina, and the diagnosis was confirmed by identification of the organism in the direct smear. But a fortnight later the membrane had disappeared and had been replaced by a profuse dark red growth resembling granulation tissue, bulging out from the surface and as large as the tonsil. This mass was removed with a snare and was histologically proved to be of hypernephromatous tissue. The patient was given high voltage roentgen therapy by Coutard's method, but as the report was made within three months after the start of treatment, no results could be reported.

Newhart and his associates[48] found that the incidence of tuberculosis of the tonsils in 112 tuberculous adults was 42 per cent. If the 12 patients without pulmonary tuberculosis were eliminated, the incidence would increase to 48 per cent. Serial sections of the excised tonsils would materially increase the incidence. This was demonstrated by means of a study of 20 pairs of tonsils, in 4 of which tuberculosis was found. These had previously been reported as normal after the usual microscopic study. In a control series of 100 routine tonsillectomies, the incidence was 1 per cent, positive evidence of tuberculosis being found in the tonsils of a patient who had previously been treated for active pulmonary tuberculosis. Tuberculosis of the tonsils is a "latent" lesion in that there is rarely enough destruction of the tonsillar substance to cause "gross" or ulcerative lesions. The tubercles in the tonsil are usually in close proximity to the cryptal epithelium. The

47. Menger, L. C., and Arons, I.: Metastatic Hypernephroma of the Tonsil, Laryngoscope **44**:748, 1934.

48. Newhart, H.; Cohen, S. S., and Van Winkle, C. C.: Tonsillectomy in the Tuberculous: Incidence and Pathology of Tuberculosis of the Tonsils in Adults, Ann. Otol., Rhin. & Laryng. **43**:769, 1934.

tubercles are primarily epithelioid in type, with giant cells nearly always present. Caseation is noted in about half the cases and is not marked. The tonsils, in the authors' opinion, become infected by tubercle-laden sputum secondary to the open tuberculous pulmonary lesion. No instance of primary tonsillar tuberculosis could be demonstrated in their series. Tonsillectomy in the tuberculous, when the patients are carefully selected and prepared, safeguarded by a proper operative technic and given the postoperative care demanded by their condition, presents no special hazard that would justify failure to perform tonsillectomy when indicated.

Hudson and Wollaston [49] cite a case of tuberculosis of the tonsils, in which, in view of the history of frequent attacks of tonsillitis with enlargement of the glands during the last two years, each lasting about a fortnight, and the microscopic appearance of the tonsils, it seems possible that the tonsils were the site of the primary lesion and that the lung became infected from them during attacks of bronchitis. From the rapidity with which the disease spread in the lung, there can have been little resistance to tuberculosis, such as would have been the case if the present infection were a reactivation of an old childhood focus in the tracheal glands. At present there are no signs of infection anywhere else, and now that the tonsils have been removed and the diseased lung collapsed successfully, the prognosis should be fairly good, though sudden activity of the miliary type of tuberculosis or meningitis is always a possibility.

Kristenson [50] is convinced that infections always involve a toxic impairment of the tissues of the body. One of the most frequent functional disorders resulting from the toxic action of infections is a cardiovascular disturbance. The cardiac action and the peripheral circulation are impaired. Manifestations of the latter disturbance are changes in the fluid exchange between the blood and the tissues. The volume of the involved portion of the body enlarges to the extent to which the disturbance in the fluid exchange between blood and tissues increases the fluid content of the tissues. This increase in volume can be measured by different methods. The author describes the method that he employed first on normal persons, then on patients with mild infections and finally on patients with tonsillar angina. In healthy persons fifteen minutes of standing increased the volume of the leg by from 0.6 to 2.5 per cent. This increase disappeared within thirty minutes after the horizontal position had been assumed. In persons

49. Hudson, B., and Wollaston, G. L.: Massive Tuberculosis of Tonsils: Case, Tubercle **17**:30, 1935.

50. Kristenson, A.: Aspects of a Latent Tendency to Edema in Tonsillar Angina, Acta med. Scandinav. **86**:315, 1935.

with infections of the upper air passages, particularly in those with tonsillar angina, the course of the test was different; either the increase in volume was greater than that in normal persons or it did not disappear with the normal rapidity when the horizontal position was assumed. The author concludes from this that the existing infection produces impairment of the tissue, with functional disturbance of the fluid exchange between the blood and the tissues.

In an investigation of the clinical relationship of infections of the upper respiratory tract in certain kinds of uveitis, Gill [51] found evidence of chronic infection of the tonsils in 61 of 120 patients, or 58.33 per cent.

In discussing the tonsils as foci of systemic infection Nissen [52] states that there are four types of tonsillar and nasopharyngeal reaction indicating infection which may cause systemic disorders: 1. Acutely infected tonsils with or without abscess formation. 2. The red, hypertrophied chronically infected tonsils, with or without symptoms. 3. The type of tonsil which is purplish red over the anterior pillar, particularly in the portion overlying the upper half as well as the edges of the soft palate and at times the uvula. This type of tonsil may have retrotonsillar adhesions or abscesses. 4. The infectious lymphoid tissue in the nasopharyngeal cavity itself. This is considered a greater focus of infection than is realized. Nissen points out that intelligent and successful choice of the time of operation depends on the study of each patient. The methods of preliminary investigation are described in detail.

Nissen [52] carried out an intensive study of a group of 500 patients with arthritis. A detailed study of this group from the point of view of the pharynx and nasopharynx as foci of infection showed certain outstanding facts: that before the onset of arthritic symptoms 10 per cent had had tonsillectomy performed and 90 per cent had retained their tonsils intact.

To learn more about the association between tonsillar infection and disorders of the joints Nissen [53] studied nearly 500 arthritic patients. Even without recognized association between infection of the upper part of the respiratory tract and infection of the joints, such association may be present. Proof of this depends on intensive study

51. Gill, W. D.: The Clinical Relationship of Infections in the Upper Respiratory Tract to Certain Types of Chronic Uveitis: A Preliminary Report, Ann. Otol., Rhin. & Laryng. **44**:486, 1935.

52. Nissen, H. A.: Tonsils as Foci of Systemic Infection, Ann. Otol., Rhin. & Laryng. **44**:187, 1935.

53. Nissen, H. A.: Arthritis and Tonsillar Infection, New England J. Med. **212**:1027, 1935.

of the patient to determine three factors: 1. Recognition of obvious and concealed chronic infection in the nasopharyngeal tissue. The two most common are unmistakable, the acutely infected tonsil and the red, hypertrophied chronically infected tonsil. The third is possibly of greater importance and is often missed unless the patient is seen frequently, and the appearance, subsidence and reappearance of signs of infected lymphoid tissue are noted. On examination of a throat with this type of involvement, a purplish red discoloration is seen on the anterior tonsillar pillar, along the edges of the soft palate and at times in the uvula. These local changes are somewhat constant (the dusky discoloration being present at all times) but show varying reactions to exogenous and endogenous infection. During such reactions the tonsillar poles become prominent and more inflamed, but this is noted only if the upper part of the tonsil is exposed. The duration of the reaction is short if the excitor is of endogenous and long if it is of exogenous origin. 2. Recognition of involvement of the joints and of other systemic infection. This depends on thorough physical, laboratory and roentgen examination. 3. Determination of the association between involvement of local areas and points and systemic infection by extensive and prolonged study of each patient.

In discussing the part played by the tonsils and adenoids in the etiology of rheumatic fever, Coates and Gordon [54] emphasize that every part of the pharynx and the fauces should be examined with care. Even after a tonsillectomy has been performed, the fossae should be diligently examined for stumps, tags, regrowths, small crypts concealed behind the pillars or beneath scar tissue, compensatory hypertrophy of the lateral pharyngeal folds, isolated lymphoid masses on the posterior pharyngeal wall, infected adenoid remnants, infected lymphoid structures on the base of the tongue, the importance of which has been emphasized by others, as well as the gravitation of infected secretions from infection of the posterior series of sinuses or an extension of inflamed mucosa.

In discussing the treatment of rheumatism, Graham [55] reports that to 3,000 tonsillectomized patients questionnaires were sent out asking if the operation was done on account of rheumatism. Replies were obtained from 1,257. Of these, 819 stated that the operation was done for reasons other than rheumatism. Of the remainder, 300 claimed that they were entirely free of rheumatism, 100 were improved to various degrees and 38 claimed that there was no improvement.

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54. Coates, G. M., and Gordon, W.: The Part Played by the Tonsils and Adenoids in the Etiology of Rheumatic Fever, Laryngoscope **44**:876, 1934.

55. Graham, H. B.: The Treatment of Rheumatism, Ann. Otol., Rhin. & Laryng. **44**:181, 1935.

From the results of his study of factors that influence rheumatic disease in children, based on a study of 1,200 rheumatic children, Kaiser [56] states in his summary:

1. Rheumatic infection is a common complaint in certain sections of the country.

2. It occurs at all ages of childhood but most frequently between the ages of 8 and 10.

3. It occurs most frequently in Rochester during the late winter and spring months.

4. Rheumatic disease in children may manifest itself with mild manifestations such as sore throat, fatigue, anorexia and pallor.

5. No social or economic factors play any significant part in the control of this disease.

6. Rheumatic infection is essentially a chronic disease and tends to recur in more than 50 per cent of the cases.

7. Recurrences of the disease are much less likely to develop five years or more after the initial infection.

8. Rheumatic infection occurs slightly more often in children whose tonsils have not been removed at the time of the initial attack.

9. The mortality rate is nearly 50 per cent less in children whose tonsils had been removed at the time of the initial attack.

10. Recurrent attacks were not lessened in tonsillectomized children or in those who were tonsillectomized after the initial attack.

11. Hemolytic streptococcus nucleoprotein skin tests were positive in 75 per cent of the rheumatic children as compared to 32 per cent of nonrheumatic children.

12. Tonsillitis or sore throat was the preceding infection in 59 per cent of the rheumatic children.

13. The most severe cases of rheumatic infection followed attacks of tonsillitis and dental infections.

14. Respiratory infections are an important factor in causing recrudescences of the rhemuatic phenomena.

15. One may assume the existence of some constitutional susceptibility to rheumatism, but no proof is available.

Zimanyi [57] states that operations on the tonsils performed on account of endocarditis complicating tonsillitis are often attended by untoward results. The diminished defensive power of the organism may be shown by calculating the bacteriologic index. One may determine the time to operate by this diagnostic method. The normal index is between 50 and 55, which means that the organism is in a positive defensive phase. When this index number prevails, complications after

56. Kaiser, A. D.: Factors That Influence Rheumatic Disease in Children, Based on a Study of One Thousand Two Hundred Rheumatic Children, J. A. M. A. **103**:886 (Sept. 22) 1934.

57. Tonsil Operations on Cardiac Patients, Budapest letter, J. A. M. A. **103**: 620 (Aug. 25) 1934.

operations on the tonsils may be averted. If the bactericidal index is lower when the patient presents himself for operation, he is in a negative defensive phase; postoperative complication is to be feared, and the operation should be postponed.

Curtius and his associates [58] performed tonsillectomy on 41 patients with endocarditis. In 29 they removed the tonsils during the nonfebrile interval and in 12 during the acute attack. They found that tonsillectomy is readily accomplished during the acute attack, although hemorrhage and postoperative increase of temperature are more frequent than in the case of operations during the interval. Bacteriologic examination of the tonsils revealed hemolytic streptococci, particularly in the septic forms of the disease. In a case of endocarditis lenta in which Streptococcus viridans was demonstrated in the blood, this organism was not demonstrable in the tonsils. In 2 patients with endocarditis lenta, neither the blood nor the tonsils contained pathogenic microorganisms. The tonsillar micro-organisms of 2 patients were examined for cardiotrophic behavior, but such behavior could not be proved. Of 23 surviving patients, who were reexamined later, only 3 complained of occasional difficulty in swallowing and of irritation of the throat. These symptoms were probably caused by nasal abnormalities that existed previous to the tonsillectomy. In cases of this type disorders of the nose should be corrected. In 8 cases of endocarditis lenta the tonsillectomy neither retarded nor checked the fatal course. Thirteen of 23 patients with endocarditis showed disappearance of the cardiac symptoms together with the pharyngeal symptoms. Septic and rheumatic manifestations were favorably influenced in 14 patients. In febrile florid endocarditis, tonsillectomy brought no advantages, and the authors think that it should be done during the interval when the patient is free from fever. They observed that existing cardiac lesions often improve after tonsillectomy. However, they found that if signs of decompensation exist before tonsillectomy is done, a continuous exacerbation may be expected. Involvement of the kidneys is no contraindication to tonsillectomy, but the renal symptoms as a rule are only slightly influenced by it. The subjective condition of the patients with endocarditis improved generally to the extent to which the cardiac and pharyngeal symptoms improved. A discrepancy between the subjective and objective aspects could be traced to psychic factors in 2 patients.

Regarding the justification for the frequent removal of tonsils now practiced, Tilley [59] states that for many of the subacute and chronic ailments of children up to the age of puberty and even adolescence no

58. Curtius, F.; Dieker, W., and Wirth, E.: Tonsillectomy in Endocarditis, München. med. Wchnschr. **81**:89, 1934.

59. Removal of Tonsils, London letter, J. A. M. A. **102**:629 (Feb. 24) 1934.

treatment is so quickly restorative to normal and prolonged good health as the removal of diseased and enlarged tonsils. On the other hand, he states that in children as well as in adults a great variety of conditions are attributed to septic tonsils without adequate examination of the patient for other possible causes of symptoms. Attention was also called to the not infrequent appearance of lymphoid hypertrophy in the pharynx causing unpleasant symptoms following tonsillectomy.

In discussing the question "What is a septic tonsil?" Tilley remarks that the presence of bacteria and plugs does not constitute an adequate indication for the removal of the tonsils. In regard to chronic tonsillitis, the dictum of Hajek was stated, that the most certain proof of chronic tonsillitis is always the occurrence of repeated acute attacks but if such attacks are few and far between, the tonsils may equally be condemned on the following grounds: (1) the escape of pus from the crypts when pressure is applied to the tonsil, (2) enlargement of the tonsillar gland behind the angle of the jaw as well as of the other glands in this region, (3) a purplish red tinge limited to the anterior pillar and (4) abnormal preponderance of leukocytes in material from the tonsillar crypts. The size of the tonsil is no criterion of the degree of sepsis within it. A large tonsil may be far more harmless than another which is small, retracted and fibrous. Once chronic infection has been established, the tonsils should be removed. Tilley also called attention to certain local and general factors which may cause enlargement and inflammation of the tonsils. He stated that if conditions were more frequently recognized and treated, many tonsillectomies would be unnecessary.

Hollander [60] quotes from Maximow's textbook on histology a clear-cut description of the lingual tonsils, which is accompanied with three excellent illustrations. Maximow says:

> The bulgings on the root of the tongue are caused by spherical accumulations of lymphoid tissue; they are peripheral nodules with germinal centers—the lingual tonsils and the follicles of the tongue. On the free surface of each of them a small opening can be noticed. It leads into a deep, irregular invagination lined with stratified squamous epithelium—the crypt. The epithelium of the crypt is surrounded by lymphoid tissue; innumerable lymphocytes infiltrate the epithelium and assemble in the lumen of the crypt, where they degenerate and form masses of detritus with desquamated epithelial cells and bacteria. The excretory ducts of the follicles open into the crypt or on the free surface.

Hollander states:

> The importance of the lingual tonsils arises from the fact that a considerable number of the medical profession is not mindful of their existence and also that some of the abnormalities which occur in them are not sufficiently familiar. Although they may be involved in any one of what Boyd calls the "big four" of

60. Hollander, L.: The Lingual Tonsils and Some of Their Common Abnormalities, J. A. M. A. **102**:1151 (April 7) 1934.

causes of pathologic changes of the tongue—syphilis, carcinoma, tuberculosis and inflammation—they are much more frequently the seat of simple hypertrophy, residual infection or hyperkeratosis of the epidermis overlying them.

These simple conditions are frequently viewed with great alarm, as they are interpreted as malignant disease. Attention is usually called to them, during routine examination of the throat or mouth. Subjective symptoms occur infrequently and only when they are the seat of residual infection. Occasionally patients who are in the habit of looking at their tongues become aware of their presence and become greatly alarmed by finding these lesser or greater lumps.

I have made it a point to observe them for some time on routine examination of the tongue. Mostly they protrude but slightly from the margin of the organ at the root; the opening of the crypt is small under normal conditions. As they are part of the lymphoid structure of the body, they are not infrequently found enlarged in patients in whom generalized lymphoid hypertrophy occurs.

Dissimilarity in size or an increase in the aperture of the cryptic opening, which may become deep and fissure-like, calls for careful examination. In the latter instance it is not infrequent to find that a semisolid, cheesy material can be expressed from the crypt; in several instances I have noticed an offensive odor associated with it. One such example is noteworthy to record because the patient's chief complaint was fetor ex ore. Only the left lingual tonsil was enlarged sufficiently to widen the crypt. Removal of the tonsil-bearing area of this side of the tongue improved the condition.

Subjective symptoms do occur in conjunction with residual or chronic infection. Especially is this true if the opening is insufficient to permit the easy outflow of the purulent material. At times this leads to fairly marked tenderness; the symptoms are usually exaggerated on mastication.

In an extensive investigation for the purpose of finding an objective clinical sign of chronic tonsillitis which would be demonstrable in all cases of this disease, Krainz and Lang [61] found that in all cases of chronic tonsillitis there are sensitivity to pressure in the tonsillar fossae and hardening of the posterior side, which can be noted on palpation of the fossae from the exterior. Histologic examination of 50 tonsils in such cases disclosed, in addition to the well known picture of chronic inflammation of the lymphatic tissue and the crypts, thickening, cicatrization and induration of the capsule and trabeculae of the connective tissue, thickening of the vascular walls, the accumulation of plasma cells and other inflammatory cells between the fibers of the capsule and the trabeculae and around the blood vessels and nerves as well as around bundles of muscle. Comparative examination of tonsils which did not exhibit sensitivity to pressure in the fossae showed less cellular infiltration and the absence of extensive cicatricial formations in the capsule and musculature. The objective clinical sign thus appears to be explained by the inflammation within the capsule and the muscle. These conditions are to be interpreted as the result of inflammation extending beyond the boundary of the tonsil. Despite the cicatricial contraction of the capsule,

61. Krainz, W., and Lang, F. J.: Recognition of Chronic Tonsillitis, Monatschr. f. Ohrenh. **67**:1096, 1933.

the muscular function is preserved. The objective sign here described is the major clinical sign in the recognition of chronic tonsillitis.

Jannulis [62] lays especial weight on the significance in the diagnosis of chronic tonsillitis of the objective sign of sensitiveness of the tonsillar niche to pressure produced by palpation from the outside. This sign can sometimes be made to disappear by employing conservative treatment instead of tonsillectomy. His conservative method involves massage and irrigation of the tonsillar crypts with methyl violet and collargol. The massage involves the buccinator, buccopharyngeal, glossopalatine, stylopharyngeal, glossopharyngeal, styloglossal, levator veli palatini, tensor veli palatini, pharyngopalatine, salpingopalatine and internal pterygoid muscles. In a patient with chronic tonsillitis, whose condition is described in detail, the local symptoms and the general symptoms of lack of appetite, poor general condition and disturbed sleep were improved by this conservative method of treatment. The erythrocyte count increased from 3,600,000 to 4,600,000, and the percentage of neutrophil leukocytes increased from 50.5 to 60.

Hutter [63] also believes that tenderness to pressure on the tonsil from inside the throat and to a lesser degree under the angle of the jaw is at times a valuable aid in the diagnosis of chronic tonsillitis.

By means of aspiration, Olivetti and Malan [64] investigated the tonsils of patients presenting nephropathy, polyarthritis, rheumatism and cryptogenic sepsis. Of the various generalized reactions following tonsillar trauma, the authors consider the changes in the leukocytes, whether preceded by leukopenia or not, as signs of tonsillar involvement. The absence of quantitative variations would indicate that the tonsils are not affected. They preferred aspiration to tonsillar traumatization, such as massage, rolling and thermal stimulations, because, when produced by means of a suitable instrument, aspiration causes a constant traumatism in all cases and is a traumatizing maneuver, which often rids the tonsils of numerous cheesy deposits. The authors first took a leukocyte count and then aspirated the tonsil for from thirty to forty-five seconds with a Worms-Le Mee glass pipet, the aspirating force being furnished by an electric motor of one-fourth horse power. After this the leukocyte count was taken every fifteen minutes for the first hour and every thirty minutes during the next two or three hours. In a number of patients for whom the test gave positive results the tonsil was the seat of a latent chronic infection. In considering the miniature

62. Jannulis, G. E.: Conservative Treatment of Chronic Tonsillitis, Monatschr. f. Ohrenh. **68**:612, 1934.

63. Hutter, F.: Diagnosis of Chronic Tonsillitis, Monatschr. f. Ohrenh. **68**:49, 1934.

64. Olivetti, R., and Malan, E.: Clinical Significance of Investigation of the Tonsils, Minerva med. **1**:535, 1934.

focus resulting from aspiration, the authors accept the hypothesis of superinfection rather than reinfection, the reaccession of disease symptoms being interpreted on the theory of a renewed passage of germs through the old point of entry. The recrudescence of articular pain, hematuria or fever observed after tonsillar aspiration is important, especially when the disease of the patient did not previously indicate a focal origin. The authors emphasize the clinical importance of the curves showing absolute and relative neutrophilia. The curve indicating only leukopenia shows that the tonsils are not involved. All such patients presented absolute neutropenia in addition to absolute and relative lymphopenia.

Some dyscrasias of the blood present such marked manifestations in the throat that otolaryngologists may be consulted before conference is held with an internist. Jones [65] points out that these dyscrasias may be suspected from the results of simple and common laboratory procedures. In all cases in which dyscrasia is suspected adequate laboratory examination should be made. In all cases, particularly those in which manifestations of dyscrasia appear before operation, the history should contain definite information regarding any previous hemorrhages: further, in all cases the bleeding and coagulation time should be determined before operation.

In discussing the differential diagnosis of enlargement of the lymph glands of the neck, Farquharson [66] mentions the various causes of this condition. Although tonsillar disease is a common cause of enlarged glands, emphasis is placed on the consideration of other conditions, such as tuberculous adenitis, Hodgkin's disease, lymphosarcoma and other conditions in which the local enlargement is associated with general involvement of the lymphatic system.

The appearance of early pharyngeal lesions of agranulocytosis is described by Costen.[67] Attention is called to the frequency of lesions on the anterior pillars of the tonsils. The lesions described represent merely a solution of tissue or a part of the necrotic process which proceeds on the surface of the tonsil. The 3 patients who were presented by Costen gave a history of regular ingestion of large amounts of drugs for years. One patient who recovered had a definite relapse on further ingestion of large doses of a sedative drug. These cases present evidence of the depressing effect of drugs on the function of the bone marrow.

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65. Jones, E. H.: Throat Manifestations of the Blood Dyscrasias, South. M. J. **26**:550, 1933.

66. Farquharson, R. F.: Differential Diagnosis of Enlargement of the Lymph Glands of the Neck, Ann. Otol., Rhin. & Laryng. **44**:662, 1935.

67. Costen, J. B.: Agranulocytosis: Appearance of the Early Pharyngeal Lesion, Arch. Otolaryng. **19**:125 (Jan.) 1934.

According to Larsen,[68] doubt exists as to the etiology and pathology of agranulocytosis. Some regard it as a special affliction provoked by an unknown agent. Others believe that there is a general infection breaking down the leukopoietic system, whereas others consider that the fault originates in the bone marrow and that the other symptoms and signs follow a state of low general resistance. A case reported by Larsen appears to be one of agranulocytosis of secondary development.

The patient was a woman 49 years old with a history of repeated attacks of tonsillitis complicated two years before by abscess formation. Ten days before admission she was attacked by pain in the throat, with rigors; an exudate spread over the fauces, and there was much swelling of the cervical glands. Repeated examinations for diphtheria bacilli gave negative results. After her admission to the hospital a small peritonsillar abscess was opened. The patient became worse, jaundice developed and a phlegmonous infiltration of the neck came on, which when incised yielded serous pus. The tonsils were removed under local anesthesia, and the throat appeared to settle down; the temperature fell, and the condition improved. The neutrophil count fell to normal and then gradually decreased; so roentgen treatment was given to the long bones. The condition became worse; the lesions of the throat broke out afresh, with faucial exudate, and death eventually took place.

The condition is believed to be agranulocytosis caused by infection with toxic effect on the bone marrow. The question as to whether the removal of the tonsils was a factor in the cause of the malady is discussed.

The subject of lymphogranulomatosis and its significance in the diagnosis of diseases of Waldeyer's ring is presented by Sobol.[69] Important points in diagnosis, differential diagnosis and treatment as well as illustrative case reports are presented. He concludes that there is reason from the present state of knowledge to suppose that in cases of early diagnosis local circumscribed forms of lymphogranulomatosis may be found. In many instances it is most difficult to differentiate lymphogranulomatosis of Waldeyer's ring from malignant tumor; biopsy is therefore indicated. Operative treatment combined with roentgen therapy is considered the most rational form of treatment.

Nagasawa[70] reports a case of acute lymphatic leukemia with gangrenous tonsillitis. In the course of anemia and swelling of the

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68. Larsen, B.: A Case of Secondary Agranulocytosis, Acta oto-laryng. **21**:13, 1934.

69. Sobol, I. M.: Lymphogranulomatosis and Its Significance in the Diagnosis of Diseases of Waldeyer's Ring, Ann. Otol., Rhin. & Laryng. **43**:851, 1934.

70. Nagasawa, Y.: Acute Lymphatic Leukemia with Gangrenous Tonsillitis, Oto-rino-laring. ital. **8**:327, 1935.

lymphatics, the patient, aged 4 years, complained of sore throat with high fever. The soft palate was deep red, and the left tonsil was swollen and its upper pole necrotic. Bleeding from the gums and from the intestines supervened, but without enlargement of either the spleen or the liver. The microscopic examination of the blood showed the presence of acute lymphatic leukemia, and the patient died a week later.

A patient with infectious adenopathy presented by de Marval and Pons [71] had an enlargement of all the upper lymph glands and a red swollen throat. The blood showed 14,000 white cells, with 78 per cent neutrophils. Glomerular nephritis eventually developed. In the differential diagnosis in such a picture lymphatic leukemia, agranulocytic angina, basilar adenitis, malignant lymphogranuloma and infectious adenitis must be considered.

The term "infectious mononucleosis" is employed by McKinlay [72] in order to avoid the rather loose use of the term "glandular fever," which is sometimes found in the literature and embraces such conditions as cervical adenitis. Owing to the benign character of this disease, it frequently may be overlooked and confused with such acute infections as tonsillitis, pharyngitis, cervical adenitis and influenza. His studies are based on observations made on 50 university students, who have been seen during the past twelve years.

A generalized enlargement of the lymphatic glands was the outstanding and constant clinical feature. The adenopathy apparently began and reached its maximum in the cervical triangles and was out of all proportion to the intensity of the lesion in the pharynx. Suppuration did not occur, but the enlargement of the lymphatic glands sometimes persisted up to twelve months. The symptoms were malaise, headache, sweating and chills, listed in the order of frequency. The signs in the throat were injection of the fauces, with swelling of the lymphoid tissue and, occasionally, membranous angina indistinguishable in appearance from diphtheria.

The total leukocyte count varied, the maximum being 32,550. There was lymphocytosis, both relative and absolute (the proportion being 50 per cent or greater), in all cases at some time during the course of the disease. The percentage of granulocytes noted in initial counts was known to drop as much as 63 per cent as the leukopenia gave way to moderate leukocytosis.

Direct smears and cultures from the throat showed occasional Vincent's organisms, but no characteristic observations were made.

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71. de Marval, L., and Pons, R. G.: Extreme Adenopathy, Arch. med. de Hosp. Ramos Mejia **15**:87, 1932.

72. McKinlay, C. A.: Infectious Mononucleosis: Clinical Aspects, J. A. M. A. **105**:761 (Sept. 7) 1935.

Blood cultures repeatedly gave negative results. Emulsions of fresh glandular substance, made during the acute stages, were injected into monkeys and guinea-pigs without demonstrable effect. The constancy of the adenopathy suggests that the essential lesion and habitat of the etiologic agent are in the lymph nodes. An article by Downey and Stasney follows, in which the changes in the blood are described in detail.

Holtz and Friedman [73] described a transitory, deep red eruption, which occurs and recurs on the mucous membrane of the mouth and throat, chiefly in association with chronic rheumatic endocarditis. The lesions are small, circular and nonelevated; one or several may be present; they are most frequently seen on the buccal mucosa and vary from the size of a pinpoint to 2 mm. in diameter. They vary in color from the crimson of fresh hemorrhage but may be darker or bluish. The duration is brief, the lesions often disappearing or fading considerably in twenty-four hours and being succeeded by a new crop. They regard the eruption as a nonembolic, hemorrhagic exanthem.

Saito [74] reports a case of severe Vincent's angina in which a man aged 24 complained chiefly of pain in the left side of the throat; ulceration started in the upper pole of the left tonsil and extended to the right tonsil and then to the faucial pillars, the uvula and the soft palate. There were high fever, leukopenia and monocytosis. Intravenous and local administrations of arsphenamine were of no avail, but antidiphtheritic serum checked the extension of the ulcer. Recovery took place, but an extensive loss of substance and rhinolalia aperta remained.

In a man of 38 with bilateral pinkish gray swelling and stiffening of the pharyngeal pillars, uvula and tonsils, with difficulty in swallowing and persistent otalgia, Scalzitti [75] found uniform hyperplasia of the connective tissue, with marked plasma cell infiltration, throughout the parenchyma, clinching the diagnosis of secondary syphilis.

Mainzer [76] reports 2 cases of syphilis of the tonsil. Chancre of the tonsil is unilateral as a rule and rarely occurs on both sides. Sore throat is usually the first symptom noted by the patient and is followed by swelling of the tonsil and eventually by enlargement of the regional lymphatic glands. Syphilis of the tonsil must be differentiated from acute tonsillitis, Vincent's angina, diphtheria, peritonsillar abscess, malignant disease and tuberculous ulcer.

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73. Holtz, E., and Friedman, G.: A Hemorrhagic Eruption of the Mouth and Throat in the Rheumatic State, Am. J. M. Sc. **187**:359, 1934.

74. Saito, Y.: Severe Vincent's Angina, Oto-rino-laring. ital. **8**:449, 1935.

75. Scalzitti, M.: Syphilitic Angina with Tonsillo-Palatine Plasmocytoma, Valsalva **11**:375, 1935.

76. Mainzer, F. S.: Syphilis of the Tonsil: Report of Two Cases, Laryngoscope **45**:466, 1935.

According to Brittingham,[77] sore throat and tonsillitis in early syphilis are relatively common symptoms of this disease. He found subjective complaints of sore throat and objective evidence of tonsillar disease in 28.8 per cent of 803 patients with secondary and early syphilis. One hundred and twenty-five, or 24.9 per cent, of 502 patients with secondary syphilis had evidence of tonsillar abnormality. One hundred and seven, or 35.5 per cent, of 301 patients with syphilis just beyond the secondary stage presented signs of tonsillar disease. Emphasis is placed on the importance of routine serologic tests for syphilis in all adult patients with sore throat of more than one week's duration, particularly if constitutional symptoms are absent.

Gill [78] emphasizes the importance of recognizing torulosis of the upper respiratory tract. The lesions may involve not only the tonsils but the mucous membrane in other parts of the respiratory tract. Important points in diagnosis and treatment are outlined.

A technic for improving the study of the nasopharynx is described by Rüedi and Zuppinger.[79] The soft palate and the posterior pharyngeal wall are first anesthetized in the usual way. The contrast fluid is injected behind the soft palate or preferably by means of a flexible catheter into the nasopharynx. Iodized poppy-seed oil 40 per cent seems to be the best fluid for this purpose, and about 12 to 15 cc. is used. Two views are taken of the hanging head. With a turned, half axial view the central rays are directed at the chin and the external auditory canal; the side view centers on the external auditory canal. The turned, half axial view normally shows on both sides wide stripes of the contrast medium, with nearly parallel border contours. Toward the nasopharynx the shadows gradually recede. In the anterior nasal region the smooth contours are broken by the conchae. The septum can be seen in the middle. Occasionally, in the region of the epipharynx, two symmetrical, sharply circumscribed humps can be seen, which represent Rosenmüller's fossae. The roentgenogram thus produces topographic evidence which is lacking to the unaided eye. This simple procedure establishes in every case the space-limiting process and gives definite evidence of the place, form and extensiveness of the change. The kind of process cannot be definitely established by the roentgenogram; in general, smooth, regular contours speak for a benign tumor, but biopsy and histologic examina-

77. Brittingham, J. W.: The Sore Throat in Early Syphilis, Ann. Otol., Rhin. & Laryng. **44**:990, 1935.

78. Gill, W. D.: Torula Mycosis in Man, with Special Reference to Involvement of the Upper Respiratory Tract, with Case Reports, Ann. Otol., Rhin. & Laryng. **44**:702, 1935.

79. Rüedi, L., and Zuppinger, A.: Contract Roentgenographic Studies of the Nasopharynx, Ztschr. f. Hals-, Nasen- u. Ohrenh. **35**:500, 1934.

tion are essential. The authors recommend this procedure as of considerable aid in diagnosis.

In certain cases diagnosis by palpation and rhinoscopic examination is difficult or unjustifiable. Roentgen examination skilfully done gives a clear picture of the size of the adenoid and of the space in the epipharynx and can be carried out during sleep if necessary. Lately Groth [80] has examined patients with adenoids with the roentgen rays to discover to what extent the passage through the epipharynx is affected by different positions of the head and by sleep. The profile picture is best suited for the study of these relations. In a normal child in the upright position the passage is broad and spacious and is affected only inconsiderably by different positions of the head. With adenoid vegetations in the epipharynx, the roentgen picture presents another appearance. A considerable swelling on the posterior pharyngeal wall represents the pharyngeal tonsils, and the soft palate appears as a shadowy band narrowing backward below the adenoid, with a thin lumen of air between, which indicates the narrow epipharyngeal passage. The appearance is then practically the same whether the patient is in the recumbent or in the sitting position when the picture is taken.

According to Kully,[81] there are comparatively few reports of cysts and retention abscesses in the literature on diseases of the nasopharynx. He believes that scarcity may be due to failure to comprehend and diagnose these conditions rather than to their rarity, as this report shows. A group of 88 cases which came under his personal observation are reviewed. This material is presented in the hope of emphasizing the importance of more thorough examination of the nasopharynx. These conditions of the nasopharynx were discussed from the standpoints of incidence, pathologic picture, symptoms, diagnosis and treatment.

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80. Groth, K. E.: The Roentgen Picture of the Epipharynx of Children Under Normal Conditions and When Adenoid Vegetation Exists, Acta radiol. **14**:463, 1933.

81. Kully, B. M.: Cysts and Retention Abscesses of the Nasopharynx: A Report of Eighty-Eight Cases, J. Laryng. & Otol. **50**:317, 1935.

(To be concluded)

Abstracts from Current Literature

Ear

Severance of All Semicircular Canals in Pigeons. E. Huizinga, Arch. f. d. ges. Physiol. **236**:52, 1935.

All the semicircular canals were severed in ten pigeons. The birds could fly normally and could even be used as carrier pigeons. Thus the loss of the semicircular canals as receptors for angular acceleration can be compensated, and the orientation of carrier pigeons may remain preserved. In the animals that were operated on tonic reflexes acting on the muscles of the neck could still be elicited from the cristae.

E. Spiegel, Philadelphia. [Arch. Neurol. & Psychiat.]

Acoustic Stimulation of the Vestibular Apparatus. G. V. Békésy, Arch. f. d. ges. Physiol. **236**:59, 1935.

By means of a model of the internal ear it was shown that acoustic stimuli may induce whirl movements of the perilymph. Pressure on the wall of the membranous labyrinth results and is transmitted to the otoliths, causing disturbances in equilibrium. Such disorders in equilibrium were observed in normal men if the sound pressure was above 100 dynes per square centimeter. Synchronous oscillations of the head were observed when vibratory tones from three to five vibrations per second were used. Deviation of the head was produced by gradually decreasing tones.

E. Spiegel, Philadelphia. [Arch. Neurol. & Psychiat.]

Catarrhal Disturbances of the Eustachian Tube. M. Krassnig, Arch. f. Ohren-, Nasen- u. Kehlkopfh. **140**:155, 1935.

Krassnig calls attention to the fact that the tendency to ascribe the disorders of hearing accompanying so-called acute and chronic catarrhs of the eustachian tube to the negative pressure resulting from closure or stenosis of the tube is unsatisfactory in a great number of cases. He stresses that the retraction of the tympanic membrane in acute tubal catarrh is by no means always caused by the reduction in the pressure of air in the tympanic cavity but may be due to a contraction of the tensor tympani or to an inflammation of the tympanic membrane. The disturbances of hearing in acute tubal catarrh, inasmuch as they can be alleviated by use of the catheter, are chiefly due to muscular changes—to impairment of the function either of the muscles within the ear or of the tubal muscles. The mobilization of the sound conduction chain by aspiration is a valuable therapeutic measure. Simple retraction of the tympanic membrane does not necessarily indicate tubal occlusion. There is also a tubal stenosis of noninflammatory origin. This form is of only slight importance for the hearing capacity, for it does not result in retraction and its sequels.

Editor's Abstract.

Operative and Postoperative Treatment of Mastoiditis. G. Bondy, Monatschr. f. Ohrenh. **69**:1322 (Nov.) 1935.

Bondy points out that as early as 1911 he recommended primary suture for uncomplicated mastoiditis. Later he came to dispense entirely with tamponade and used only glass drains. Regarding the operation he says only that he attaches great importance to the prevention of unnecessary bruising of the wound and is especially careful in the detachment of the periosteum, so that smooth cutting edges, without

tears, will result. Bleeding vessels are clamped but not ligated. The clamps can usually be removed at the end of the operation, and ligation is no longer necessary, except that the vessels may be grasped at the time the suture of the skin is made. The operation on the bone is the one that is generally employed; that is, it aims at complete removal of the diseased portions and at formation of a smooth-walled cavity. After completion of the operation on the bone the author resorts to tamponade by means of a long strip of gauze saturated with methylamino-aceto-ortho-di-oxybenzol, in order to prevent profuse hemorrhage into the wound cavity. The end of the strip of gauze is led outward at the lower angle. The skin is sutured close to the protruding strip of gauze. Then the strip is withdrawn, and a glass drain is introduced in the direction of the antrum. A strip of sterile gauze is placed in the auditory meatus. The after-treatment is simple, for the glass drain remains in situ and only the external bandage is changed; that is, the saturated gauze is replaced by new gauze. The wound itself remains undisturbed. The sutures are removed on the fourth or the fifth day, and a few days later, when the secretion has become serous, the drain is removed. However, if the tympanic cavity is not yet dry or if the discharge is still suppurating, the drain is left in place. The opening at the lower angle of the wound closes rapidly after the removal of the drain. The author says that he employs this method in all cases in which there are no complications but that it cannot be used if intracranial complications are present. He lists shortening of the process, painless after-treatment and excellent cosmetic results as the chief advantages of the treatment.

EDITOR'S ABSTRACT.

DISORDERS OF HEARING IN PATIENTS WITH CEREBELLAR TUMOR. H. BRUNNEI, Monatschr. f. Ohrenh. **69**:1329 (Nov.) 1935.

Brunner reports a case in which a cyst developing from a glioma in the left hemisphere of the cerebellum resulted in a severe auditory disturbance on that side. However, five days after the surgical opening the capacity for hearing was slightly improved, and twenty-eight days after the operation the hearing was normal. Thus the case is an example of transitory deafness associated with a large cyst of the cerebellar hemisphere. The author sees the cause of the auditory disturbance in stasis and concludes that in cases of cerebellar tumor auditory disturbances may result not only from degenerative changes in the brain stem but also from dropsy caused by stasis in the internal ear.

EDITOR'S ABSTRACT.

VALUE OF ROENTGEN EXAMINATION IN INFLAMMATORY DISEASES OF THE TEMPORAL BONE. B. WORNING and A. JÖRGENSEN, Ztschr. f. Laryng., Rhin., Otol. (Teil 1: Folia oto-laryng.) **26**:325 (Nov.) 1935.

Worning and Jörgensen, after reviewing the history of roentgenography of the temporal bone and describing the methods of projection, discuss the conditions that can be clarified by roentgenography. In order to estimate the value of roentgenography in diseases of the temporal bone, the authors review the material in 600 cases of disease of the ear in which observation was made in the Finsen Institute from 1924 to 1934. First, they analyze the material in 401 cases of chronic suppuration of the middle ear. Roentgenographic examination of the mastoid processes of 180 patients on whom operation had not yet been performed disclosed that the roentgenographic aspects differed from the clinical aspects in 15.5 per cent of the cases. The decision of whether or not an operation should be performed was always based on the clinical symptoms. In about 53 per cent of the cases in which operation was performed the surgical observations tallied with the roentgenographic aspects; in about 42 per cent roentgenographic examination disclosed less severe changes than did the operation, and in 5 per cent there was contradiction between the roentgenographic aspect and the observations at operation. In about half of the patients on whom operation had previously been performed there was agreement between the roentgenographic and the surgical

aspects. A review of the cases in which cholesteatoma occurred indicates that roentgenoscopy is of only slight value in the diagnosis of cholesteatoma, for the roentgenogram indicated the presence of cholesteatoma in only 8 of a total of 36 cases. Thus, a negative roentgenogram does not exclude the existence of cholesteatoma. Analysis of the cases of acute suppurating inflammation of the middle ear convinced the authors that in the acute form roentgenography is of great value in the determination of the type of pneumatization and the extension of the cell system. Veiling of the cells is not an indication for operation, for it may persist for a long time after the process has taken its course. Only if the walls of the cells are indistinct and there are perhaps signs of disintegration can the condition be diagnosed as osteitis. The authors state that the roentgenologic aspects of tuberculosis of the middle ear are the same as those of simple chronic suppuration and that the detection of tuberculosis of the middle ear is impossible by means of roentgen rays. It is pointed out, further, that for tumor, traumatic injury, Paget's disease and so on roentgenoscopy is of great value; however, in diseases of the internal ear (otosclerosis, Ménière's disease and the like) roentgenoscopy shows no characteristic changes. The authors reach the conclusion that roentgenoscopy is necessary in the examination of chronic disorders of the middle ear.

EDITOR'S ABSTRACT.

DEAFNESS AS A SEQUEL OF OSTEOMYELITIS. A. RAINER, Ztschr. f. Laryng., Rhin., Otol. (Teil 1: Folia oto-laryng.) **26**:344 (Nov.) 1935.

Rainer thinks that osteomyelitis is one of the rarest causes of bilateral deafness. He emphasizes that he does not refer to osteomyelitis of the petrosa but to osteomyelitis of the skeletal system, in the course of which impairment of the internal ear may develop. He asserts that nine cases in which this condition appeared have been reported so far, and in view of the rarity of the involvement he feels justified in reporting the instance which he observed. The case concerns a man, aged 26, in whom multiple osteomyelitis existed for sixteen years. Fifteen years after the onset of the osteomyelitis there developed, with the symptoms of tinnitus aurium and vertigo, bilateral progressive hardness of hearing, which, in the course of a year, resulted in complete deafness, the vestibular apparatus being entirely unresponsive to stimuli. The author further calls attention to similarities between his case and those that have been reported in the literature. Nearly all the authors have stressed the severity of subjective ear sounds. In the author's case tinnitus aurium persisted even after deafness had become complete. The author is not certain about the pathologico-anatomic processes that underlie deafness in association with osteomyelitis. After reviewing some of the suggestions made by other investigators, he is inclined to believe that in the majority of cases there develop on the trunk of the acoustic nerve changes like those that were described by Brock, namely, degenerative toxic neuritis. He assumes that bacterial toxins may be the etiologic factor in this type of neuritis.

EDITOR'S ABSTRACT.

Pharynx

TECHNIC AND COMPLICATIONS OF TONSILLECTOMY. E. ERTL, Monatschr. f. Ohrenh. **69**:1345 (Nov.) 1935.

Ertl describes a technic of tonsillectomy which reduces the possibility of the entrance of bacteria into the blood and lymph channels and thus guards against complications.

EDITOR'S ABSTRACT.

CLINICAL ASPECTS OF RETROPHARYNGEAL ABSCESS. E. RUTTIN, Monatschr. f. Ohrenh. **69**:1349 (Nov.) 1935.

After citing descriptions of the typical form of retropharyngeal abscess as it occurs chiefly in children, Ruttin points out that in adults retropharyngeal abscess does not always take a typical course, so that the diagnosis may be extremely

difficult. He demonstrates this in the histories of three cases. A fourth case concerns a child. In this latter case the swelling of the retropharyngeal glands subsided without the formation of abscesses. In the three adults there were no signs of disease of the cervical portion of the vertebral column, and tuberculosis of the retropharyngeal lymph nodes must be assumed, which resulted in the formation of a retropharyngeal abscess. Wide incision finally resulted in cure. In this connection Ruttin points out that Meyer has warned against the incision of such abscesses, but in view of the results obtained in the cases under discussion Ruttin thinks that for adults at least this warning is not justified. The bacteriologic examination of the abscesses disclosed mixed infection (streptococci or streptococci with diplococci), and cure was effected in spite of the tuberculous infection.

EDITOR'S ABSTRACT.

TWO RARE FORMS OF SEPTICEMIA FOLLOWING ANGINA. H. CLAUS, Ztschr. f. Laryng., Rhin., Otol. (Teil 1: Folia oto-laryng.) **26**:290, 1935.

Claus first reports the history of a man aged 54 who had severe angina, which was followed first by otitis media, necessitating paracentesis, and later by nephritis, with severe hematuria from the left kidney. Since the patient's condition became steadily more grave, nephrectomy was performed. The left kidney showed the signs of metastatic nephritis in association with sepsis, that is, numerous cortical abscesses. The patient recovered rapidly after the operation. How the course of the disease might have ended if nephrectomy had not been performed the author is unable to state. The second case concerned a nurse who continued her service while she had an attack of angina, with increase in temperature. She stated later that she had had only slight coating and pain on the left side of the throat. A week later she limped and complained that her knee was swollen. Rest in bed was ordered. After another eight days swelling of the left side of the neck and the left arm appeared. Examination revealed thrombosis of the external jugular vein and of a vessel running above and parallel with the clavicula. The author refrained from exposure of the veins because there was no increase in temperature, and the manifestations gradually disappeared without intervention. Six weeks later the patient was subjected to enucleation of the tonsils. At this time severe infiltration and necrosis developed, but these disappeared. However, the patient complained that if she took fluids they came back through the nose. Since there is no mechanical explanation for this backflow of fluids, the author ascribes it to impairment of certain nerves. He states that he heard of another case in which temporary swelling of the arm developed after infection of the throat.

EDITOR'S ABSTRACT.

Larynx

DISORDERS OF SPEECH. SUZANNE BOREL-MAISONNY, Rev. franç. de puériculture **2**:279 (Nov.) 1934.

The complexity of the study of disorders of speech is due in part to the fact that while the same causes always produce the same effects similar effects may be engendered by very diverse causes. Pathologic sounds such as those due to laryngospasm, hoarse breathing and nasal twang are found in children with paralysis of the soft palate, adenoids, the high arched palate typical of the mongolian idiot or cleft palate. Spasmodic disorders are found in stammerers, persons with epilepsy, mongolian idiots and subjects suffering from meningeal irritation or the sequelae of encephalitis. Delayed speech, with baby talk and voice, is noted in normal children as well as in mentally deficient children.

CRANE, Chicago. [AM. J. DIS. CHILD.]

LOGOPEDIC SUGGESTIONS IN CASE OF AMPUTATION OF THE LABIUM VOCALE. E. FRÖSCHELS, Monatschr. f. Ohrenh. **69**:1356 (Nov.) 1935.

Fröschels points out that following amputation of a labium vocale, there frequently develops scar tissue which, with its median rim, reaches to the middle of the glottis and takes part in the formation of the voice. The result is an extremely noisy, almost croaking voice. Efforts to improve the condition by functional therapy are usually unsatisfactory. In one case the author was able to effect some improvement by avoiding waste of breath in the course of speaking and by better utilization of the resonance of the head. He says further that in the course of the therapy of unilateral weakness of adduction, for instance in paralysis of the recurrent nerve with intermediate position, he gained experience that might also be of use after amputation of the labium vocale. Whereas others try to have the healthy labium vocale advance beyond the median line in case of unilateral weakness of adduction, he avoids this and rather works for a sparing use of the expiratory stream of air and tries to avoid hyperfunction. Stroboscopic examination of a patient who had been treated in this manner revealed that the labium which was in the intermediate position participated in the formation of the voice with an essentially lesser amplitude than did the one with normal motility. Fröschels suggests that if surgical measures will make it possible to keep the scar tissue somewhat in the lateral direction after excision of a labium vocale, it ought to be possible to modify the voice by the same method which he uses with good results in cases of unilateral paralysis of the recurrent nerve with intermediate position.

EDITOR'S ABSTRACT.

Miscellaneous

OBSTRUCTIONS OF THE TRACHEA. L. COLLEDGE, J. Laryng. & Otol. **50**:897 (Dec.) 1935.

Colledge says that the causes of tracheal obstruction can be divided into (1) extrinsic lesions which cause compression of the trachea and (2) intrinsic diseases in the tracheal wall itself. In the first group are a large variety of conditions, such as mediastinal tumor, enlarged glands and aneurysm. The most common in this group are goiter and cancer of the esophagus. In the case of benign goiter the indication is clear: Enough of the goiter—whether in the neck or in the thorax—should be removed to relieve the pressure on the trachea. The real difficulty is presented by the dyspnea which is caused by malignant goiter and is often accompanied with paralysis of the vocal cords. The same often applies to esophageal cancer which gives rise to this kind of complication. In a case of malignant goiter, whether the cords are paralyzed or not, no attempt should be made to do a tracheotomy. Much the same applies to attempts to relieve the obstruction by König tubes, long flexible tubes which are intended to pass down through the obstruction. The trachea is so much covered by the growth that there will probably be the same trouble, although the plan is to open the trachea higher up. Crile suggested that relief may be obtained through decompression of the neck by dividing the sternothyroid and sternohyoid muscles, so that the tumor will be allowed to expand outward. But often the malignant disease has invaded the muscles and they are infiltrated and fixed by the growth, so that it is not likely that any large measure of relief is to be obtained in this way. After reviewing several cases, the author says that disease of the tracheal wall itself causes stenosis rarely. He mentions syphilis, tuberculosis and neoplasm. Syphilis occurring in this situation, apart from syphilis of the larynx, seems to respond well to antisyphilitic treatment, without leading to stenosis, as it is likely to do in the larynx if it is much advanced before treatment is begun. Tuberculosis of the trachea, apart from tuberculous laryngitis, is rare. In this connection the author reviews an interesting case, describing the measures resorted to in order to overcome stenosis and obstruction. Primary tumor of the trachea is rare, but it is said that

sarcoma is at least as common in this location as carcinoma. The first diagnosis made in these cases is almost always asthma. The author reviews two histories in which this was the case.

EDITOR'S ABSTRACT.

OBSTRUCTIONS OF THE TRACHEA. F. C. ORMEROD, J. Laryng. & Otol. **50**:903 (Dec.) 1935.

Ormerod says that he was induced to make this report because in the museum of the Brompton Hospital there are examples of almost every type of tracheal obstruction. He does not include in this summary obstruction due to the inhalation of foreign bodies, and when these cases are eliminated, the lesions arising within the lumen of the trachea become few. There is, however, a specimen at Brompton Hospital of a pretracheal gland which became enlarged, eroded its way through the anterior wall of the trachea and fell down to the bifurcation, where it lodged. The patient got out of bed, fell on the floor and died. There are several cases in which such a gland has lodged in a bronchus, but these do not come within the scope of the present discussion.

There are two main types of obstruction due to lesions arising in the wall: cicatricial stenoses and new growths. He mentions an instance of syphilitic structure, instances of stenosis following the wearing of a tracheotomy tube and one of stenosis following a bullet wound just below the larynx. Further, he describes a specimen of a trachea from a tuberculous patient. There are scarring and stenosis in the lower part of the trachea, which are assumed to be due to syphilis. There does not appear to be any real evidence as to the syphilitic nature, and the specimen belongs to the days before the Wassermann test was used. There are several similar specimens, all from tuberculous patients, but it is rare to find tuberculous lesions—particularly tuberculous stenosis in the trachea. It is possible that the condition may be of syphilitic origin.

A new growth of the trachea may originate in the tracheal wall or may invade it from the thyroid and thymus glands, from the esophagus or from the upper lobe of the lungs, where it originates in a small bronchus and often reaches the lumen of the trachea by direct infiltration before it emerges from the main bronchus of the upper lobe. In the larynx one tumor is malignant to seven that are benign, but in the trachea the proportion is one to three. Symptoms of tumor in the trachea are dyspnea and a feeling of pressure behind the sternum or in the region of the larynx, according to the site of the lesion. There may be blood-stained sputum and stridor. The stridor is usually both inspiratory and expiratory, as opposed to the inspiratory stridor associated with laryngeal obstruction and the expiratory stridor that accompanies bronchial obstruction. The voice is affected only when the recurrent nerves are involved, and this involvement is surprisingly uncommon. Dysphagia is described as occurring when the esophagus is infiltrated, but probably the lesion often begins in the latter organ in such cases.

There are a number of examples in recent literature of tumor growing into the lumen of the trachea and probably originating in the wall. After citing several of these cases, the author says that obstruction of the trachea from causes arising outside is the most common type. Stenosis of the trachea from long pressure from an enlarged thyroid is common. After citing several cases from the literature, the author says that he had the opportunity of examining two patients with a similar condition with the bronchoscope. In one there was fusiform aneurysm of the left common carotid artery, pressing on the left wall of the trachea and causing a moderate degree of obstruction. In the other there was a saccular aneurysm of the arch of the aorta causing flattening of the trachea in an anteroposterior plane. The pulsation of the blood vessels was obvious in each instance. Both patients survived bronchoscopic examination and were able to return home.

Three other specimens from the Brompton Hospital are illustrated. One showed flattening of the trachea from behind forward by an enormous lymphoma of the mediastinal gland. A second showed stenosis of the lower part of the trachea due to endothelioma of the thymus. The third was that of a retrosternal

goiter in a woman aged 59 who had severe dyspnea, but who made a complete recovery after removal of the thoracic portion of the thyroid gland. This patient's left recurrent nerve was paralyzed, and the condition was thought to be carcinoma, but histologic examination showed the growth to be a simple adenomatous goiter with degenerative changes. EDITOR'S ABSTRACT.

NEW OR LITTLE KNOWN THERAPEUTIC METHOD IN OTORHINOLARYNGOLOGY. L. FORSCHNER, Monatschr. f. Ohrenh. **69**:1354 (Nov.) 1935.

Forschner gives his attention first to local anesthesia in the opening of peritonsillar abscesses. He makes a depot of a 0.5 per cent solution of procaine hydrochloride in the masseter muscle of the diseased side so as to counteract a possibly existing locked jaw; then he injects a 2 per cent solution of procaine hydrochloride into the side of the uvula toward the abscess, and from there the anterior palatine arch and the base of the tongue are infiltrated. After ten minutes the abscess is opened according to one of the customary methods. The second therapeutic method discussed by the author is the anesthesia of the auriculotemporal nerve in certain types of otalgia, particularly in those caused by arthritis mandibularis. He concedes that in most cases of postinfluenzal arthritis mandibularis conservative measures, such as treatment with a salicylate, are sufficient. There are also cases in which the condition is refractory. Moreover, the rare carcinoma of the anterior wall of the auditory meatus may be accompanied with severe neuralgia of the auriculotemporal nerve. Forschner anesthetizes the nerve in the upper portion of the fossa retromandibularis. He says that the anesthesia can be induced from the oral cavity as well as from the outside. He prefers the latter method. He injects 2 cc. of a 0.5 per cent solution of procaine hydrochloride, but in order to prolong the effect 1 cc. of a 70 per cent solution of alcohol may be injected after the anesthetic has taken effect. EDITOR'S ABSTRACT.

SIGNIFICANCE OF SO-CALLED CHONDRO-OSTEOPLASTIC TRACHEOPATHY AND SENILE CHANGES OF THE TRACHEA. V. TANTURRI, Monatschr. f. Ohrenh. **69**:1358 (Nov.) 1935.

Tanturri discusses histologic observations which he made in four cases of so-called tracheopathia chondro-osteoplastica. This disorder is characterized by the presence of cartilaginous and bony nodules in the mucous membrane of the trachea and occasionally even of the chief bronchi. Tanturri says that in the cases he studied the histologic aspects differed greatly, not only as regards the number and extent of the noodules but also structurally. In one case he found chiefly cartilaginous nodules, and in another he found mostly bony nodules. In two of the cases syphilis existed, in one alcoholism and in the fourth tuberculosis. Regarding the genesis of the nodules, it has been suggested that they originate either from the tracheal ring or directly from the connective tissue of the mucosa. Tanturri's observations indicate that they are always cartilaginous formations from the tracheal ring. In the beginning the nodules are formed by the cartilaginous tissue; their structure is hyaline with collagenous fiber bundles. Later ossification sets in. In summarizing the histologic characteristics of the so-called tracheopathia chondro-osteoplastica, the author stresses the following points: (1) perichondral new formation of cartilage with collagen-elastic fibers, (2) periosteal and enchondral ossification of the newly formed cartilage, (3) degenerative and compensatory processes in the tracheal cartilage, (4) hyperplasia of the fibroelastic tissue of the trachea and (5) extensive degeneration and infiltration of the connective and glandular tissue. Tanturri considers it noteworthy that the same phenomena are found in the trachea in persons of advanced age. He detected this in the course of histologic studies on thirty-two tracheas of persons of various ages. However, he emphasizes that these manifestations of "advanced age" appear earlier in some than in others. In chronic disease which influences the organic metabolism, they appear earlier in life. EDITOR'S ABSTRACT.

Society Transactions

AMERICAN OTOLOGICAL SOCIETY

Sixty-Ninth Annual Meeting, Detroit, May 28-29, 1936

FRANCIS R. PACKARD, M.D., *President, Presiding*

ABSTRACTED BY ROBERT SONNENSCHEIN, M.D., CHICAGO

(Concluded from page 551)

Thursday Afternoon Session, May 28

THE NATURE OF BONE CONDUCTION AS SHOWN IN THE ELECTRICAL RESPONSE OF THE COCHLEA. ERNEST GLEN WEVER, PH.D., and CHARLES W. BRAY, PH.D., Princeton, N. J.

In these experiments the fundamental nature of bone conduction has been investigated by comparing the electrical response of the cochlea produced by this form of stimulation with that produced by air-conducted sounds. This comparison is made, first of all, in terms of the functional relation between the magnitude of the cochlear response and the intensity of sounds conducted to the ear by the two methods. A further comparison is made in terms of the relative effects of lesions in the middle ear.

Electric potentials from the round window of the guinea-pig were observed by means of a cathode ray oscillograph on stimulation with sounds from a loud speaker and from a bone conduction receiver. For each type of stimulation, the intensity was determined in absolute units.

With frequencies of 300, 1,000 and 3,000, the results indicate for each frequency a general similarity in the intensity functions for both air-conducted and bone-conducted sounds. The curves have slopes which are the same or nearly the same for the two forms of stimulation. One feature of the air conduction curves, that of bending over at high intensities of sound, is not shown by the bone conduction curves, but the reason for this difference is uncertain; the intensity of stimulation by bone conduction was not sufficient for a thorough exploration of this portion of the response curve.

Further results reveal the effects of lesions in the middle ear on both air conduction and bone conduction. After the incudostapedial joint of the ossicular chain was broken, the responses to bone-conducted sounds were changed much less than those to air-conducted sounds. In about half the cases the responses for bone conduction showed no significant alteration; in the remaining cases decreases up to 20 decibels were noted. The responses for air conduction showed decreases which ranged from 50 to over 80 decibels, in most cases between 60 and 70 decibels.

Following the study of lesions of the middle ear, the blood supply of the cochlea was eliminated, and the animal was killed by pithing the medulla. Immediately after the operation the responses for both air conduction and bone conduction showed a rapid decline.

The results show in quantitative terms the part played by the middle ear in the processes of air conduction and bone conduction. Destruction of the ossicular chain causes a serious impairment of sensitivity to air-conducted sounds but has relatively little effect on sensitivity to bone-conducted sounds. On the other hand, the two kinds of conduction give rise to essentially similar processes in the inner ear.

DISCUSSION

DR. HEINRICH KOBRAK, Chicago: Under normal conditions the two muscles of the middle ear react to sound with tetanic contractions. The length of the contraction is determined by the duration of the tone; the strength is dependent on the intensity and the frequency. The movements of both muscles can be easily observed in the animal (rabbit). In man the contractions of the stapedius muscle have been observed in a number of patients with a perforation of the posterior half of the ear drum. Owing to its normal muscular movements this reflex offers a suitable means of testing cochlear function objectively both in the animal and in man.

In studying the rôle of the ossicular chain in bone conduction the following observations have been made:

Destruction of the drum membrane, hammer or incus does not diminish the cochlear function for bone-conducted sounds. On the contrary, a slight but definite improvement of bone conduction has been observed.

After extirpation of the stapes irritation of the cochlea by bone-conducted sounds can still be demonstrated. Bezold's conception that bone-conducted sounds enter the cochlea only via the stapes has therefore not been corroborated in the experiment with animals.

In producing lesions of the sound-conducting apparatus, a strong impairment of function for air-conducted sounds has been observed. Since there is no parallel loss of bone conduction, the normal ratio between air conduction and bone conduction is reversed (negative Rinne reaction in the experiment with animals). Lesions in the inner ear diminish cochlear function for air-conducted and bone conducted sounds alike (diminished positive Rinne reaction in the animal).

The conditions of the Schwabach test can be reproduced in the animal by testing the bone canal under normal conditions and after a lesion has been made. The observed increase of bone conduction in the presence of lesions of the middle ear is real; that is, it is not produced by masking phenomena. The reflex shows no change in the presence of a masking tone provided the masking tone itself is under the tensor threshold. Experiments with man as to the sensation of hearing indicate a definite masking effect if one uses the same acoustic stimulation used in the experiment with animals. In man the stapedius reflex observed in the presence of a masking tone did not show any change, while the sensation of hearing of the same person equally tested did give the phenomenon of masking. The acoustic irritation originating in the cochlea and determining the strength of the tensor contraction apparently is the same regardless of the presence or the absence of a masking tone. Therefore, the phenomenon of masking is apparently not located in the peripheral sense organ.

The rôle of the intralabyrinthine fluid for sound conduction has been studied in the following experiments: If one drills a fine hole in the apical part of the cochlea of the rabbit, one can observe the escape of fluid and the functional changes connected with it. The lesion of the cochlear structures can be kept localized strictly to the place of the drill hole, at least as far as is demonstrable histologically. A loss of function increasing with the progressive escape of labyrinthine fluid can be observed. The effect is about equal in bone conduction and air conduction. If the drill hole is allowed to heal, one can observe remaining function, since the inner ear apparently is then under more favorable hydrostatic conditions.

E. A. CULLER, PH.D., Urbana, Ill.: Investigations on the hearing of animals at the University of Illinois have dealt primarily with other phases of audition; so I have little to contribute on bone conduction.

I have used two receivers, the Western Electric device and the acousticon. The efficiency, or output, of each was tested at the seven octave frequencies from 125 to 8,000 cycles by attaching it to a silvered quartz crystal bar and measuring the electric potentials generated therein by the mechanical impacts. The response of

the Western Electric receiver is fairly uniform from 250 to 4,000 cycles, dropping off at 125 and 8,000. The response of the acousticon receiver is less uniform, being more efficient than the Western Electric receiver from 500 to 2,000 cycles but less efficient at the extremes (125, 4,000 and 8,000).

With one cochlea destroyed, the dog is trained to respond to air-borne sound. A silvered screw is then turned directly into the bone of the zygomatic arch, and the bone conduction receiver is attached. In this way firm and uniform contact is assured. To make sure that I am testing true auditory thresholds and not merely tremor or tactile sensitivity, the remaining cochlea is destroyed after all desired tests are completed and the animal's response is again measured. In one case, for example, the bone limens with the cochlea were 57, 75 and 51 decibels below the standard sound, whereas the bone limens without the cochlea were 19, 22 and 0 below the standard. The cochlear thresholds are therefore far below the non-cochlear; within that interval one may reasonably assume that the animal is responding to sound and not to tactile stimulation. A few preliminary observations, not systematic or definitive, are given in the full report.

Dr. Simon Dworkin, Montreal, Canada: When tested by a conditioning method, totally deaf cats perceive sounds when placed in an intense sound field. The frequency limits are from below 100 cycles to 1,000 cycles, where a sharp cut-off occurs. The threshold intensities between 100 and 800 cycles vary from 105 to about 80 decibels above that of normal hearing at 1,000 cycles. The responses cannot therefore be attributed to the levels of pain or feeling established by Fletcher and his co-workers. Most probably these intense sounds are perceived as follows: (1) at frequencies from 100 to at least 600, by tactile receptors in the feet and legs, (2) at frequencies from 100 to 1,000, by tactile receptors in the skin; the animal's fur has great ability to pick up and pass on these tremors.

An Experimental Study of Bone Conduction. Dr. Walter Hughson, Philadelphia.

Changes in electric potential in the auditory nerve of the cat produced by bone-conducted stimuli have been investigated. The technical difficulties inherent in such a study—magnetic and electrical interference, mechanical vibration of electrodes, cross-effect, etc.—have been checked and overcome. In order to evaluate all phases of the problem it has been found necessary to use a nerve rather than a cochlear electrode. In the presence of an open bulla bone conduction is definitely reduced, and this effect becomes more apparent when the septum is removed. To obtain constant conditions of stimulation a metal screw is put into the hard palate and the receiver tip is placed on the head of the screw with a pressure of the receiver's own weight. One ear is destroyed after the control bone conduction audiograms for both ears have been made. Frequencies of 180, 250 and successive octaves to 8,000 double vibrations are used in all tests. Departure from the control level in decibels of intensity, whether improvement or impairment, is then measured for each experimental condition.

It was found that bone conduction was actually improved after the external canal had been blocked with petrolatum gauze. This effect was manifested only if the bulla had been left intact. Air conduction was much impaired. After removal of the gauze there was a prompt return to normal.

Incision of the tympanic membrane produced a marked effect on bone conduction. With an extensive incision bone conduction was entirely lost for the two low frequencies, while air conduction was only impaired. In contrast to these findings separation of the incudostapedial joint results in complete loss of air conduction, while bone conduction shows only slight impairment.

In another series of experiments tension was exerted on the tensor tympani tendon. Impairment in transmission is in direct proportion to the amount of tension used. Although both air conduction and bone conduction are affected, the latter response is impaired to a greater extent than the former. In addition, bone conduction fails to return to its control level when the tension is released.

These data obtained from a large number of experiments are presented more as a series of observed facts than in an effort to establish any theory of bone conduction. Many factors enter into the production of the phenomenon. The effective mass of the ossicular chain, its elasticity, phase changes in vibrations passing through the skull and the ossicular chain and impedance of the tympanic membrane must all be taken into consideration in attempting to make any final analysis. On the other hand, the results obtained indicate definitely that the conductive mechanism of the ear in experimental animals plays a major part in transmitting bone-conducted stimuli to the sensory cells of the cochlea. So important is this particular route that transmission by bone conduction at a standard intensity of stimulus can be completely eliminated by experimental procedures carried out on structures of the middle ear. The demonstration of this fact depends entirely on elimination of the possible sources of error emphasized. The fact that response by bone conduction can be so changed attests to the effectiveness of the precautions taken in these experiments.

END-ORGAN DEAFNESS IN DOGS DUE TO THE APPLICATION OF CERTAIN AGENTS TO THE ROUND WINDOW. DR. E. P. FOWLER JR., New York.

Changes noted both by the Wever and Bray method and by histologic observation were reported for dogs whose round windows had been treated with sodium chloride and with calcium chloride. In addition, there was actual loss of hearing by dogs after the round window was treated with sodium chloride. It was suggested that some of the nerve deafness which occurs after long-continued suppuration of the ears may be due to the poisoning of the hair cells in the lower turns of the cochlea by electrolytes seeping through the round window.

DISCUSSION

DR. MOSES H. LURIE, Boston: I am much pleased to find that in a number of ways Dr. Fowler Jr. has confirmed some of the work that my associates and I have reported in the past year. I was interested in his attempt to produce deafness by chemical means and to get the same histologic result we have obtained by exposing the animals to loud tones. He also shows a similar condition that we are beginning to notice in some of the animals that we are breeding, which are congenitally deaf. I am sorry that I have none of the slides of the congenitally deaf animals to show, but I do have slides showing conditions similar to what Dr. Fowler has demonstrated.

The loss of hearing was greatest with the greatest amount of destruction. In the second turn of the guinea-pig's cochlea, we noted the greatest loss, from 40 to 60 decibels, while the least loss was toward the apex. As the external hair cells began to come back into the picture, so did the hearing of the animal begin to come back.

DR. HARVEY FLETCHER, PH.D., New York: What was the sound?

DR. M. H. LURIE, Boston: The sound was 2,500 double vibrations for about a month at an intensity of 100 decibels.

The electro-audiograms of this animal showed a consistent loss, between 40 and 50 decibels, throughout the range up to 8,000.

There are two types of deafness, one due to a disease, the other to exposure to a loud tone for a considerable length of time. Dr. Fowler now gives the chemical results; I have tried to determine these by feeding animals with chemicals, but I have not succeeded as yet.

(A number of slides were shown to illustrate the points made.)

DR. E. L. ROSS, Chicago: A little over a year ago I reported some work on the use of chemicals in the middle ear and observed the effect on the vestibular function. The placing of cocaine, procaine hydrochloride, quinine and sodium chloride in the middle ear for a period of about half an hour produced decided changes in the vestibular function.

In the past year I have employed the toxins of a number of different bacteria in the middle ear and have had rather interesting results. The toxins used were from streptococci, staphylococci, pneumococci and the organisms of tetanus, scarlet fever and diphtheria.

This material was put into the middle ear of dogs for half an hour. The animals were observed for a week or more. From the staphylococcus, streptococcus, pneumococcus and tetanus toxins no results were obtained; that is, the effects were negative. The toxin from scarlet fever caused a reduced reaction of the vestibular apparatus. In the course of four days the diphtheria toxin produced death of the vestibular mechanism.

Because this destruction of the vestibular function was absolute and I saw evidence of deafness in these animals, I made a series of experiments on animals that were roughly conditioned for hearing, using diphtheria toxin in the middle ear. In the course of from four to five days, absolute deafness was produced by the diphtheria toxin.

Friday Morning Session, May 29

REPORT OF THE BOARD OF TRUSTEES OF THE RESEARCH FUND OF THE AMERICAN OTOLOGICAL SOCIETY. DR. JOHN B. RAE, New York.

I am certain that every member of the society will share the deep regret of the board of trustees of the research fund that this report is made by a substitute rather than by Dr. Arthur B. Duel, who was chairman of the board at the time of his death.

The vacancy in the board due to the regretted death of Dr. Edward B. Dench after long and faithful service has already been filled by the election of Dr. John R. Page, a former president of the society.

An epitome follows of income, expenditures and allotments since the report of last year:

Present value of the permanent endowment fund, approximately	$300,000
Estimated income for the year	$ 14,500
Balance from last year	600
Total available income for year, approximately	$ 15,100

THE SECRETARY'S REPORT FROM THE BOARD OF TRUSTEES OF THE RESEARCH FUND OF THE AMERICAN OTOLOGICAL SOCIETY. DR. J. GORDON WILSON, Chicago.

Conspicuous ability and enthusiasm have been shown by various investigators. The studies progress along two main lines: pathologic and physiologic.

Pathology.—Pathologic studies have been concerned with the influence on the pathogenesis of otosclerosis of developmental abnormalities, infection before birth and in early infancy and lesions of the nervous system. Investigation of developmental abnormalities follows as a secondary stage of previous studies in embryology. As this subject is of fundamental importance, it is specially referred to at the end of this report.

Dr. Bast continues his investigations on the petrous bone in the late fetal stages and in early infancy; also on the endolymphatic duct in man and in the guinea-pig to determine the angle between the utriculo-endolymphatic duct and the common endolymphatic duct in order to determine the functional possibility of the utriculo-endolymphatic valve. His studies on the "fissula post fenestram" show that in 27 per cent it is present, but in about half of these it is a mere indication. With Dr. Eyster, professor of physiology at the University of Wisconsin, he is studying the significance of the Wever and Bray phenomenon, referred to later.

Dr. Anson has concentrated on the periotic capsule, chiefly on the area between the cochlea and the stapes. He has studied the varieties of cartilage present, the formation of sclerotic bone and its relation to the fissula and to the blood vessels. A paper has been published on Paget's disease of the petrous portion of the temporal

bone, a preliminary study to compare the disease in this location with its manifestation in other parts of the skeleton. Since into the picture of otosclerosis there comes involvement of the stapes, and as no adequate description of the development and the abnormalities of this bone could be found in the literature, Dr. Anson is studying, with the help of models, changes which occur in it from the fiftieth day of the embryo to the seventieth year in the adult. Under his supervision there has been made a large model of the petrous bone showing the relation of the air cells to the eustachian tube and the marrow spaces of the petrous tip.

Dr. Marvin Jones continues the work he was asked to do by the committee, namely, to collect material for information regarding the pathogenesis of otosclerosis. In keeping with this, Dr. Hemsath, working with Dr. Jones, has published an article on intra-uterine and neonatal otitis media. In some instances there were found traces of amniotic fluid in the middle ear, showing a foreign body reaction without organisms; in others, there was evidence of pathologic invasion by bacteria.

Dr. Fowler Sr. and Dr. Fowler Jr. continue their audiometric examinations and study of microscopic sections from persons on whom these tests were made. They discuss Dr. Albert Gray's hypothesis of the presence of definite degenerative changes in the eighth cranial nerve in otosclerosis, and cannot confirm his findings. They have made an important observation on the origin of acoustic neuroma, namely, that such tumors, large and small, seem to arise from the base of the modiolus and suggest a traumatic origin.

Physiology.—One feaure common to all reports is the use of drugs to determine the function of various parts of the peripheral auditory apparatus. Since another member of the otological society is carrying on experiments and has already published results of the application of various drugs to the vestibular mechanism, it is gratifying to find the double mechanism of the ear after the application of stimulants and depressants being studied by members of the society.

Dr. Hallowell Davis and his co-workers at Harvard University, who have published several papers, say: "We feel that the outlines of the theory of hearing are now on a firm experimental basis. Perception of pitch is determined by the stimulation of particular nerve fibers, and the degree of loudness is given by the total number of active fibers. We have begun experiments in an endeavor to detect histologic degenerations of physiologic depression of the organ of Corti produced by quinine and certain other drugs. Also we are collaborating with the department of neuro-anatomy in a study of the congenital abnormalities of the auditory and vestibular apparatus in waltzing guinea-pigs. We test electrically the functional state of the auditory apparatus and then examine the cochlear and labyrinthine end-organs histologically while our colleagues in the department of anatomy study the corresponding neural tracts. The genetic aspect of this problem promises to be one of great general interest."

They point out that masking does not occur in the cochlear response. Masking is neural; the cochlear response is not neural but is generated by the sensory cells of the organ of Corti and not by the nerve cells or nerve fibers.

Dr. Bast has studied the effect of various drugs placed in the middle ear (near the round window or the oval window) on the transmission of the Wever and Bray phenomenon, to determine whether the phenomenon has its origin in the nerve end-organs or not. "Starting with the supposition that such drugs as cocaine will deaden the nerves and the end-organs, then if the phenomenon originates in the organ of Corti or if it is an index of hearing, it should be obliterated by these drugs. Our results show that the phenomenon is not obliterated when these drugs are applied. All of them depress the low frequencies and augment the high frequencies. This cannot be explained on the basis of involvement of the nerves. These drugs may produce a change in the permeability of some membrane or may produce changes of pressure across it, resulting in lowered potentials for low tones and raised potentials for high tones."

From the McGill University, Dr. Dworkin reports on the measurement of loss of hearing in cats after lesions of the middle ear and after damage to the apex

of the cochlea. He further reports a neurosis which developed in dogs when they were exposed to stimuli of minimum audibility.

A summary is given of the anatomic work of Bast at the University of Wisconsin and of Anson and Wilson at the Northwestern University Medical School. The anatomic facts are determined; for the defects of the hypothesis Dr. Wilson assumes the responsibility.

The bony periotic capsule develops in the usual manner from primitive connective tissue, first into cartilage and later into bone. The dense connective tissue perichondrium develops into periosteal bone similar to that in the long bones of the skeleton. The cartilage is displaced by primary endochondral bone, in which is embedded intrachondrial bone (cartilage islands). This primary bone is characterized by its weblike strands, with the bone cells laid irregularly but in a direction more or less longitudinal. Elsewhere in the skeleton, for example, in long bones, this primary bone is replaced by lamellar bone around haversian canals. But not so in the petrous capsule; here haversian lamellae are few. In short, the fully formed periotic capsule consists of primary endochondral bone, reticular and not lamellar, an osseous tissue more resistant to pressure than cartilage and more pliable than lamellar bone.

In the fetus in the area between the stapes and the cochlea there is a communication between the vestibule and the middle ear filled with loose connective tissue and surrounded by cartilage, called the fissula ante fenestram. This fissula usually disappears, and the anatomic structure reaches a formation similar to that elsewhere in the periotic capsule. But the fissula may not disappear; the normal progress may be interrupted and may show developmental irregularities spreading into the surrounding spaces; for instance, the loose connective tissue may persist from before birth to late adult life; the cartilage normal in the fetus may increase and persist during life, irregular in size and location; large marrow spaces showing invasion by cartilage may be seen; there may be present abnormal bone, irregular in outline, varying in amount and sharply separated from the tissue in which it lies. In short, in the region between the stapes and the cochlea there may be present at all ages tissue of various histologic types, including sclerotic bone, irregular in outline and of varying dimensions. Though the physiologic significance of the fissula is not known, the outcome of this diversity of the tissue around it suggests that in certain cases the tissue in this area remains in a state of instability, so far as it does not reach the condition normal to the periotic capsule. The primitive constituent cells may remain unchanged in type; after a varying progress further development may be arrested, or the progress may be intermittently resumed. In the resulting picture there is a structure with irregular anatomic dimensions of varying histologic pattern.

Morphologists believe that instability of tissue is of importance in the genesis of abnormal growths. It is known that unstable tissue can be influenced by environmental factors and, further, that a stimulus which intermittently calls forth the reactivity of an unstable tissue need not be a particular stimulus. That the tissue in this fissular area retains potential activity of growth is evidenced, apart from clinical manifestations, by the ability of cartilage to spread into adjacent marrow spaces and by the formation of sclerotic bone of abnormal type so sharply marked off from the surrounding bone or tissue as to appear independent of it.

The hypothesis is that this instability of tissue is the fundamental basis of otosclerosis and that environmental stimuli, using the word environment in its widest sense, disturb the instability from time to time and lead to a growth abnormal for that locality. This hypothesis is in agreement with modern scientific opinion and fits in with clinical knowledge of otosclerosis. Anatomically unstable tissue may be present, and intermittent activity is recognized by clinicians. There is evidence that the vascular factor may play an important part. The principal vascular supply of this area both in the fetus and in the adult is from the tympanic cavity. Additional support for this hypothesis is given by a study of Paget's disease of the petrous portion of the temporal bone, which, as elsewhere in the body, causes destruction of bone followed by reconstruction by a different type of bone. While the compact cochlear capsule may be attacked, it seems to present resistance

to the progress of the destructive forces except in the area between the stapes and the cochlea. The argument is that in and around the fissula ante fenestram, between the stapes and the cochlea, there may persist into adult life tissue representing stages in the growth of the normal capsular bone, and that morphologically this tissue is unstable and under the influence of stimuli may come to irregular growth. In short: morphologically unstable, clinically vulnerable.

A Method for the Early Detection of Otosclerosis: A Study of Sounds Well Above Threshold. Dr. Edmund Prince Fowler, New York.

This article will be published in full in a later issue of the Archives.

Genetics in Otosclerosis. Dr. Max A. Goldstein, St. Louis.

The detailed investigation of an extensive otosclerotic family, with many ramifications, serves as evidence that: (1) otosclerosis is a hereditary disease of the ear and is transmissible, generation after generation, without a break, (2) otosclerosis may develop at a very early age and its insidious onset may not be easily diagnosed, (3) otosclerosis of marked degree in its usual onset may simulate congenital deafness, (4) there is no justification by evidence produced in a great number of cases that congenital deafness is hereditary, (5) there is justification for the consideration of otosclerosis as a hereditary disease, (6) there is a possibility that otosclerosis may develop in the embryo and such an embryonic otosclerotic pathologic picture may be confused with and show aspects of similarity to congenital deafness.

These observations are the result of an extensive survey of a detailed familial history and may offer data for the further development of a field which may throw some light on the origin of both congenital deafness and otosclerosis.

Twelve years ago Gustave Alexander reported the case of a 10 year old girl whom he had examined ante mortem and whose condition he had diagnosed clinically as otosclerosis. She died of an acute illness, and the examination of the temporal bone in the laboratory confirmed the clinical diagnosis, revealing typical otosclerosis as its pathologic picture is understood at present. Dr. Stacy Guild, in his routine work of sectioning temporal bones at the Johns Hopkins University otologic laboratory, reported the case of a child 1 year and 10 days old in whose temporal bone he had observed under the microscope the changes that are identified as otosclerosis of the capsule of the labyrinth.

The following conclusions can be made: 1. Deafness occurs in all four generations, an unusual condition in hereditary transmission. No previous genetic studies of otosclerosis have traced the family back more than three generations. 2. When defective hearing occurs on both sides of the family, there are: (*a*) an increase in the percentage of cases and (*b*) defective hearing at a lower age level. 3. There seems to be a relationship between other physical ailments, such as susceptibility to colds, sinus infection, nasal catarrh, poor teeth and progressive deafness. What this relationship may be has not been determined.

DISCUSSION

Dr. J. Gordon Wilson, Chicago: Dr. Goldsmith's excellent genetic report, painstaking and thorough, is a study of the incidence of otosclerosis in four families carried back four generations. Many of the data were obtained from personal examination of the patients and from interviews with relatives; in addition, when personal contact was not possible, by a questionnaire. Information so obtained is acknowledged to be of greater value than the information elicited during a routine examination in the office.

The importance of genetic studies cannot be gainsaid. Heredity is an undisputed factor in the causation of otosclerosis. One may grant that it cannot always be traced, a circumstance not to be wondered at for many reasons, including the obvious one that it is on a particular localization of the lesion that diagnosis depends. It is acknowledged that factors other than heredity play a part. Con-

sanguinity, always important in hereditary tranmission, is lacking. Since these families lived on farms, there was good opportunity to study the effect of soil and water. No such influences could be traced. It is striking how frequently nasal and postnasal catarrh comes into the picture, a fact noted also by Gray.

Dr. Fowler is justly regarded as an expert in the interpretation of audiometric graphs. His communications always repay careful study and the paper today is no exception. It is a preliminary report and is to be so regarded. It is a plea for measurement of acuity of hearing by air conduction and bone conduction, not only at threshold intensity but at higher intensities, pointing out that such graphs are capable of far reaching interpretation. The importance of early diagnosis in otosclerosis and the success which may follow early recognition are becoming generally recognized; undue pessimism has been a great drawback to success in the treatment of this malady. It is known that the disease is subject to periods of quiescence and that there are constitutional causes or environmental agents which arouse it from latency or stimulate its progress; such facts suggest the possibility of control of the lesion. With early diagnosis before the pathologic change is unalterably fixed and with recognition of the disturbing causes, otologists will advance to a more hopeful frame of mind regarding prognosis.

The underlying hypothesis enunciated by Dr. Fowler is that whatever hampers the free movement of the stapes interferes with the conduction of air-borne sounds. When the fixation is incomplete, very small movements may not be appreciably affected, and neither would minimum audibility; but with greater movement of the stapes, that is, greater amplitude, there would be an earlier noticeable defect in perception. To the former one may agree; the latter is arguable. That lesions other than otosclerosis lead to deficiency of free movement of the stapes I need not now consider.

Can one say definitely that the deficiency of hearing in otosclerosis is due in all cases to interference with free movement of the stapes? Is one to disregard cases in which there are all the clinical signs and symptoms of otosclerosis, including deficiency of hearing, yet pathologically no ankylosis is present? Dr. Gray cites such cases. On the other hand, numerous cases are reported in the literature in which there were extensive areas of otosclerosis round the oval window although the annular ligament was not affected and hearing was normal. At present the evidence available would indicate that without some fixation of the stapes deficiency of hearing does not occur.

Dr. Fowler's main contention is that in cases of otosclerosis it is from the testing of the hearing at amplitudes greater than the minimum, at which there is a larger movement of the stapes, that one will detect early deficiency and not from testing minimum audibility; to limit tests for early interference to sounds of threshold audibility is futile, for the hobbling of the stapes will have progressed somewhat before this minimum is affected. If so, then the threshold of hearing (for example, audiometric charts) no longer appears to be a dependable criterion for estimating freedom from disease. The hobbling effect is undoubtedly much smaller at threshold audibility, but so also is the energy transmitted. Since in the ligament of the stapes in which the ankylosis occurs one is dealing with a living tissue, will the hobbling effect follow ordinary physical laws? Such are a few of the disturbing questions which arise in one's mind. Dr. Fowler seems to anticipate trouble and wisely says that this is fundamentally a question for the physicist; so clinicians may happily leave the solution of their doubts to them.

In support of this hypothesis the graphs which Dr. Fowler shows and which were made in cases of nerve and conduction deafness must be carefully studied before one can decide on the clinical importance of this interesting and valuable communication. It may well be that Dr. Fowler is pointing to a new road to the early diagnosis of otosclerosis. What I have said represents the questions which have arisen in my mind since the paper was read.

R. L. Wegel, Ph.D., New York: In his exploration and comparison of perception of intensity by the two ears Dr. Fowler has opened concretely a new field, which bids fair to give useful diagnostic information concerning differentiation

between lesions of the conduction apparatus and those of the nerves. His tests are convincing because they deal not only with threshold intensities but also with the higher and more useful sound levels and because specific, easily measured results are obtained. Dr. Fowler has described the correlation of his tests with threshold acuity and has also observed that abnormality of discrimination of intensity is considered in making his tests. In regard to the last point it may be pertinent to examine the ability to discriminate changes of intensity of low tones near the threshold, which rises along a sigmoid curve to a maximum at moderate levels and remains constant as the intensity is further increased. In some cases, however, only the upper part of the curve is obtained. The absence of the lower part cannot be due to a defect of conduction. It must be related either to degeneration of nerve tissue or to an abnormal distribution of it in the first place. Some curves also show anomalous behavior at moderate intensities. These curves may be associated with Dr. Fowler's hobble or with an odd distribution of nerve tissue.

JOHN C. STEINBERG, PH.D., New York: Although it has often been said that deafened persons hear better in a noisy place or hear loud sounds normally, Dr. Fowler, by comparing the sounds heard in normal and in deafened ears, has obtained quantitative data on the effect. I have observed both the constant and the variable type of loss of hearing in tests on persons having one normal and one impaired ear. The variable type of loss has been observed also in cases in which both ears are alike and impaired over part of the range of frequency. In this case tones in the normal range of frequency are compared with tones in the impaired range. Many of the characteristics of the variable type of loss are obtained when tones heard in an ear masked by noise are compared with the tones heard in the unmasked ear.

DR. I. H. JONES, Los Angeles: Immediately after the World War it seemed desirable to me to know how well the patient heard; so I used audion bulbs, as they were then called, as amplifiers.

From patients whom I knew intimately, I was able to find that those with definite perceptive defects disliked amplification while those with purely or almost purely conductive defects liked it very much.

Then the question arose of measuring the degree of amplification at which they could hear well. In this connection, Dr. Fowler has mentioned the motion of the stapes. It seems that the point is well taken, because one billionth of an inch, I am told, is sufficient amplitude at 1,000 cycles for the drum membrane and the ossicular chain to move in order to permit one to receive an audible sensasation. On the other hand, my voice would produce a movement of one millionth of an inch, which is a thousand times greater. Consequently, it would seem easily appreciated that a faint one billionth of an inch might get by, whereas one millionth or greater amplification could not. I will show one slide simply to bring this out.

STACY R. GUILD, PH.D., Baltimore: Disregarding any conclusions that Dr. Fowler drew, tentative or otherwise, I wish to say that I think that this is an important contribution to methods for the study of hearing. He is obtaining by this new technic facts concerning balance between the ears, which, however, I wish to interpret later. I wish to draw a clear distinction between tentative conclusions now and the possible use of the data obtained.

Dr. Goldstein has submitted a fine genetic study. I have been much dissatisfied, as all otologists have been, with the usual type of report in this field. In my collection of sectioned temporal bones the majority of otosclerotic foci do not involve the foot-plate of the stapes. In other words, otosclerosis may be present histologically, but one cannot recognize the condition clinically and the patient is not deaf unless the foot-plate is involved. This is not a new observation. I mentioned it six years ago, and it is widely recognized as a fact.

Therefore, in a genetic study is it not entirely possible, indeed, probable, that in many instances a member of the family who is not clinically deaf has in the

temporal bone a focus of otosclerosis which has not chanced to invade the foot-plate of the stapes? It is an accident whether or not the annular ligament or the foot-plate is involved; the area in front of the oval window is the real place of predilection for otosclerotic foci.

The other thing is this: In all genetic studies one speaks of sporadic cases of otosclerosis or cases without a positive family history of deafness. One does not know whether or not there is in that family line histologic otosclerosis which crops out into clinical recognition at rare intervals by an accidental involvement of the foot-plate of the stapes.

HARVEY FLETCHER, PH.D., New York: I have been interested in experiments on loudness for the last fifteen or twenty years. Otologists have been confused in their thinking for a long time but are gradually getting to understand what the experimental studies mean.

I am glad to see that the otologic profession is beginning to use loudness tests in making diagnoses. It seems to me this is one of the most important contributions in the field of functional tests that have been made in recent years. I think that not only will it do some of the things that Dr. Fowler is expecting of it, but it may well contribute some information which will give a clearer picture of the mechanism of hearing, particularly on the nerve side of that mechanism.

Some years ago I made a recommendation which seems to have been taken too seriously. In Dr. Wilson's discussion he questioned the practice of using 500, 1,000 and 2,000 cycles for determining the average loss of hearing. I think I was guilty of introducing that notion, and it was done innocently and not with much experimental background. It was done to give an answer to the question which is always asked by a patient: "What is my loss of hearing?" He means by that, what is his loss of hearing for speech.

I made some experiments to determine just what the loss of hearing for speech was in patients having various degrees of loss of hearing. Then I made audiograms of about eight patients. It turned out that if I used 500, 1,000 and 2,000 cycles and averaged the results for these frequencies, I obtained nearly the same value as if I actually made the speech tests. It probably will not hold for peculiar types of deafness. It was an approximate rule, and I hope that members of the otologic profession will not take it too seriously.

DR. MOSES H. LURIE, Boston: I should like to congratulate Dr. Fowler on applying a method that has been used by Dr. Stevens in the department of psychology at Harvard University on the question of loudness, and the balancing method for discrimination of loudness in psychologic tests.

It was on account of these tests (loudness tests) that I began to look for the difference in function between internal and external hair cells of the organ of Corti. From the degenerations that I have found in animals I began to believe that the discrimination of loudness and pitch depends more on the number of nerve fibers and the activation of the internal hair cells than on the external hair cells. The work of Dr. Fowler confirms this, that in man the more intense the sound becomes, the better is the discrimination of pitch.

DR. SIMON DWORKIN, Montreal, Canada: Although a nonmember, I should like to add a comment or two on Dr. Fowler's paper. If I understand his general thesis correctly, much is based on the fact that the stapes at hearing threshold will have to move a very small distance as compared with the movement at the higher intensities and that the stapes, even when slightly impeded, may still be movable by threshold sounds, although it is greatly hindered in responding to loud sounds. That seems logical enough when one thinks in terms of the bone, but if one thinks in terms of the stimulus necessary to set it in motion, I wonder whether the hypothesis will hold.

It has been shown—for instance, by the engineers of the Bell Telephone Laboratories—that at threshold, particularly for notes of around 1,000 vibrations, the energy required to move the stapes is exceeding small, something of the order of 10^{-6} watts. It is very hard to see that it would be possible with that amount

of energy to move a bone that was in any way hampered, and therefore the threshold ought to be noticeably impaired if there is any fixation at all of the stapes.

Dr. Edmund P. Fowler, New York: Let me particularly thank Dr. Wegel and Dr. Steinberg for aiding me in this work. I am not a physicist, though I use the language sometimes glibly. It is by their help that I do it.

It is known that otosclerosis occurs frequently without deafness. It has been clinically impossible to diagnose it. I believe that the tests I have described may furnish aids for making it possible. The "hobble" hypothesis would still obtain, whether there was nerve deafness or not as well as if the nerve deafness was due to one thing or to another or whether the deafness was due to otosclerotic pressure or to pressure from other lesions.

Near minimum audibility it is difficult to sense slight changes of sensitivity, but if one observes these cases early this so-called hobble effect will not be found at near minimum audibility; it will be found some way above it. This was the thought. There is an appreciable possibility of detecting the impedance of the hobble not just before deafness but some time before.

Fibrous adhesions around the stapes will cause, in one sense, a hobble effect, but this is not what I am referring to, because adhesions do not change the ratio of the increment of loudness. It remains relatively the same throughout the intensity scale. It does not suddenly change at a critical intensity.

With regard to bone conduction, I have also balanced bone conduction against air conduction, and in the cases I have observed these also went up in parallel ways. When bone conduction is normal, there is a normal reference to compare with the low reference of the deafened ear.

Dr. Steinberg showed graphs describing the same types of phenomenon that I showed to you. As a clinician, I find it difficult to grasp his graphs as well as I can my own simple ones. I believe that my diagonal lines show the balance, or difference, better than the other methods of plotting, at least to clinicians.

As I understand it, Stevens used only relative degrees of loudness, such as half loudness, not equal balance.

Dr. M. H. Lurie, Boston: He balanced the degree of loudness from one ear to the other in order to get discrimination of loudness and also discrimination of different characteristics of sound.

Dr. E. P. Fowler, New York: Was it equal loudness?

Dr. M. H. Lurie, Boston: It was equal loudness.

Dr. E. P. Fowler, New York: I am glad to hear this.

Report of New York Committee on Otitic Meningitis. Dr. James G. Dwyer, New York.

This is the second official report of the local committee in New York.

By far the greatest problem otologists have is meningitis. The deaf person accustoms himself to conditions. Ninety-seven per cent of persons with meningitis die. The committee is trying in a feeble way to get ahead with the problem, and I was thinking as I sat here that if one tenth of the effort of otologists all over the country were devoted to a problem which is a matter of life and death, they might get somewhere.

Since the last report in New York, there have been 22 cases, with 1 recovery. The committee has met regularly three or four times to analyze the different cases.

I am proud to say that I believe that in the last year and a half 4 lives have been saved by one of the points that the committee has been stressing, namely, that a cloudy fluid without organisms means that one should operate and find the focus. I do not think that there is any doubt that this has saved 4 of the patients.

The work at present is purely educational. The committee is not attempting anything in the way of treatment because resources are limited, but we do believe that one can get tremendous help in the early diagnosis of meningitis by the

recognition of three simple factors: the blood count, the chemistry of the spinal fluid and the pathways of infection. When a patient dies of mastoiditis the members of the committee lie awake nights thinking of some error in technic. From our postmortem examinations and from other observations and analysis of the histories, I believe that most deaths ascribed to mastoiditis are practically from bacterial invasion from the nose and throat. I believe that the number of deaths due to injury or exposure of the dura is small. We have had several autopsy specimens in which it was definitely proved that the pathway was from the sphenoid sinus. I have over 6 specimens from patients on whom partial autopsy was done in which my associates and I were able to take out the base of the mastoid and to prove there that what we were dealing with was essentially an osteomyelitic process and not mastoiditis. Those patients were lost from the start.

When there is a persistently high blood count in an adult—from 30,000 to 35,000—with involvement of the mastoid or the ear, and when involvement of the chest is excluded as a cause, meningitis will develop, and one may find out from this blood count four or five days or a week in advance and be prepared. I have proved that time and time again.

Third, the question of cloudy fluid. I want to emphasize the point that a persistently cloudy fluid, loaded with cells but with no organisms, indicates that the patient can be saved. If one waits too long, meningitis will develop. As I say, I believe that 4 patients have been saved by this knowledge.

I think that the time has come when otologists ought to get busy all over the country and do the same work on meningitis that they are doing on otosclerosis. The society in New York has no money. Members are doing the work voluntarily, bearing the expense themselves. They go out day or night to any hospital that will call them. Although I am reporting 22 cases on which my associates and I received histories, I know of at least between 30 and 40 patients in other hospitals who died, for whom no reports were available. We are trying gradually to educate the hospital staffs.

We go out day or night to private or clinic patients and try to establish the diagnosis and to get autopsy material. I think the time has come when the society as a whole should establish a central committee which, as Dr. Beck is doing in the pathology section, can get the pathologic material assembled, have histories assembled and analyzed and get the correct diagnosis in cases that are reported in the literature.

At present otologists as scientists certainly ought to know whether they are dealing with true meningitis or with false meningitis, and they ought to make the diagnosis. I certainly believe that it can be made from the spinal fluid in 100 per cent of the cases. Otologists certainly ought to talk all over the country in a common language of what is meningitis and what is not.

DISCUSSION

Dr. Samuel J. Kopetzky, New York: Progress in handling meningitis in the hands of the committee has come from the study of the chemistry of the cerebrospinal fluid and from the isolation (this is a preliminary report and is to be taken with all reservations) by a bacteriologist of a substance having the nature of an enzyme. This was found in the cerebrospinal fluid from persons with streptococcic infections. It is a fibrolytic substance which creates the fibrinous deposits. The efforts of the committee, of course, are being directed toward making a substance to defibrinize the fluid and to keep the circulation going. That is one step in progress, which I want to report. A preliminary report on this was made to the American Society of Bacteriologists at its twenty-seventh annual session recently.

Reporting on the chemistry of the cerebrospinal fluid in all the various kinds of meningitis (*Laryngoscope* **45**:827, 1935), I made comparisons with the normal values, and I can show a drop in the amount of chlorides and of bicarbonates; the presence of carbon dioxide in the fluid is marked in all types of meningitis.

The finding of the quantity of these substances in the fluid is not sufficient; there must be at the same time a parallel examination of the same substance in

the blood stream—the normal amount in the blood, let us say, of lactic acid as compared with that in the blood in meningitis. In the cerebrospinal fluid, the normal values should be determined as compared with the findings in meningitis—the normal value for sodium chloride, the drop in this value in meningitis, the normal amount of carbon dioxide in the blood as compared with the normal amount in the cerebrospinal fluid, the drop in meningitis, and the small fall in the p_H as compared with that of the blood.

I have been able to keep patients with meningitis alive much longer than usual by the use of very small blood transfusions—75 to 100 cc.—irrespective of the size and weight of the patient; I have found that this restores (I never knew why) the normal chemical composition of the cerebrospinal fluid to furnish an environment less favorable to the invading organisms and to some degree inhibitory to their development. After transfusion the lactic acid content drops and the chloride content goes up. This is a trend toward normal.

I have published a report in which the same factors shown on the previous charts are placed in juxtaposition to the clinical history and the temperature curve, and it is found that long before the clinical history entirely clears up, the falling of the ratio toward the normal as far as lactic acid is concerned and the rise toward the normal of the other factors give an indication of the prognosis.

In the taking of the fluid certain precautions should be remembered. The fluid changes rapidly, and therefore it is necessary to cover it at once with paraffin at the bedside, so that there can be no leakage or evaporation. The tests should be made immediately. A second specimen should be taken for the study of the bacteria.

I think that if this work were undertaken in all the centers, physicians might learn something more about streptococcic meningitis, which might lead toward finding a curative therapy. There are more cures than are reported by the New York committee, but the records have not yet been turned over to Dr. Dwyer because of the lack of necessary clerical help to copy the histories.

*Otitic Meningitis. Dr. Alfred Lewy, Chicago.

There are now from the pediatric department of the Cook County Hospital eight temporal bones in the process of preparation, some of them so far along that study of them has begun. The work is being done by my associate Dr. Elmer Hagens, who is the Friedberg fellow at the University of Chicago.

The routine which my associates and I try to follow at the Cook County Hospital is that when a patient is admitted with a presumptive clinical diagnosis of meningitis, if the spinal fluid is found to be cloudy he is given the antimeningococcic antitoxin intravenously, as recommended by Dr. Hoyne, who is in charge of the contagious disease division of the hospital. He has recently reported before the American Medical Association some excellent results, superior to those ordinarily obtained by the intraspinal use of the antimeningococcic serum. This is done whether there is an associated running ear or not. However, if there is an associated running ear and the diagnosis of meningococcic meningitis is not positively established, in the presence of a cloudy spinal fluid and clinical evidence of meningitis, we immediately proceed to operate on the mastoid in order to uncover the dura in the middle and posterior fossa, without awaiting the result of culture.

We believe that we have saved most of our meningitic patients with cloudy fluid who had no viable organisms in the spinal fluid. If the organisms were found simply on smears, that did not discourage us. Some such patients also recovered. We have rarely saved a patient whose spinal fluid showed a positive culture. So far as we are concerned, the crux of the situation is whether or not there are viable organisms in the spinal fluid; I mean so far as the prognosis is concerned.

One more point. There are some who believe (I do not know whether it is so or not) that methenamine has a bacteriostatic value in the spinal fluid. There are some supporting experiments. We have been using it as a routine in all the borderline cases that we feel anxious about. Of course, our results are not of such a nature that we can report any positive findings.

SEPTIC PAROTITIS IN CONJUNCTION WITH ABSCESS OF THE MIDDLE EAR. DR. B. E. HEMPSTEAD, Rochester, Minn.

Three cases of suppurative parotitis complicating acute otitis media are reported. The symptoms were early pain and swelling in the parotid region, with trismus. I believe that this lesion might be confused with mastoiditis with zygomatic abscess and abscess of the pterygomaxillary fossa. I believe that the infection takes place along lymph channels and nodes in the substance of the parotid gland. Radium was used in the treatment of these 3 patients, with cure in 1 case. The lack of the usual success is thought to be due to the fact that the infection is lymphadenitis as opposed to obstruction of Stenson's duct, such as occurs in septic parotitis complicating surgical operations.

DISCUSSION

DR. JOSEPH C. BECK, Chicago. I do not remember ever having treated a patient with a condition like those that were described. According to my opinion, in only 1 of these 3 cases would the picture fit into the title of the paper. The route of infection proposed is probable, and its likelihood is an excellent point brought out by Dr. Hempstead. This lymphatic route from the middle ear to the parotid gland should be of interest to the men who study malignant disease, particularly of primary origin, in the middle ear, as secondarily infecting the parotid gland.

There are many important findings in these cases that were not but might have been described, as those in the examination of the tympanic membrane and the functional tests. Perhaps they were omitted for lack of time, but they would be interesting in connection with the involvement of the internal ear.

The use of radium in cases of infection ought to have more attention and serious consideration. In the treatment of infections—for instance, furuncles about the nose or the ear—radium will frequently abort abscess formation. That has been shown by men who are working on the therapeutic use of radium and roentgen rays. I do not know the dosage, but I have observed excellent results from such treatment.

DR. J. GORDON WILSON, Chicago: Dr. Hempstead's interesting paper suggests a question as to why septic parotitis is not more common as a sequel to disease of the middle ear when one considers the anatomic relation of the parotid gland to the middle ear and the external auditory meatus. Many years ago I showed before the Chicago Otological Society a pathologic specimen from a child showing disease of the middle ear extending into the right parotid gland (*Laryngoscope* **22**:273, 1912). The sequence was: (1) suppuration in the middle ear, (2) localized abscess in the upper part of the parotid gland and (3) subperiosteal abscess on the inferior surface of the petrous bone, with rupture into the pharynx. I then demonstrated a normal parotid capsule and its relation to the middle ear, showing how the sheath fused with the perichondrium and periosteum of the external auditory meatus and formed a relatively strong partition extending back to the petrous bone, with a weak spot where the perichondrium and the periosteum come together.

AUDIOMETRY AND THE PRESCRIBING OF HEARING AIDS. DR. ISAAC H. JONES, Los Angeles.

Audiometry has emerged from the laboratory and now assumes its place as a clinical art. There is a contrast between the scientific knowledge concerning the eye and that concerning the ear; optics has long been established as a science. The problem with the ear was to determine the condition of all those parts one cannot see. The first advance came not in auditory but in vestibular studies in the measurement of objective response of hidden structures. Optical work is impossible without precision instruments. Students of acoustics similarly needed precision instruments. Thirteen years ago ideal requirements were suggested, and twenty-five instruments were constructed, and now a new audiometer is presented designed to meet the original requirements. The technic of examinations is described, as are the details of prescribing a hearing aid. Improvements in hearing aids are mentioned, and further studies in selective amplification are indicated.

Audiometry cannot reveal a pathologic picture, but it can give data for diagnosis and the prescription of the best possible hearing aid. Physicians have long been able to secure a precise knowledge of the function of the eye. The turning and caloric tests and precise audiometric measurements at least give a key to a similar mastery of the ear.

DISCUSSION

DR. HORACE NEWHART, Minneapolis: After what has gone before in the business meeting and because of the large number of physicists and acoustic engineers present, I feel that this group can best be served by asking the president to call on a guest, Dr. Henry E. Hartig, of the department of electrical engineering of the University of Minnesota, who during the past two years has directed extensive research in a field definitely related to the matter covered by this paper.

DR. HENRY E. HARTIG, Minneapolis: I shall report some data obtained at the University of Minnesota in an investigation begun about two years ago. Dr. Newhart asked the cooperation of the department of electrical engineering at the University of Minnesota in an examination of the various commercial carbon microphone hearing aids which were on the market. My associates and I proceeded to do that, first, in a preliminary investigation, in which it became evident that many of these commercial hearing aids could be eliminated immediately as having insufficient amplification, in some cases having actually a loss instead of a gain and also a poor frequency response.

We finally narrowed the investigation down to four of the leading hearing aids of the portable type on the market, consisting of a microphone and an amplifier with ear pieces, either of the large watch-case type or of the ear-fitting type, or having the bone conduction type of receiver.

An ideal that has been expressed a great number of times is that the hearing aid should have uniform amplification over a wide range of frequency. Recently, as Dr. Jones pointed out, another ideal has been expressed, which is that the hearing aid should have selective amplification, that is, amplification which varies with frequency in some way, corresponding to the patient's loss of hearing.

Of course, it is obvious that unless hearing aids are available which satisfy one or the other of these ideals or some other criterion which may be set up in the future, the program is stopped right there. So it is important to investigate the characteristics of the hearing aids which can be obtained at the present time.

In investigating carbon microphones and in investigating acoustic problems in general a great many difficulties are encountered, as those who have ever tried a thing of that kind well know. I just want to stress that the investigation reported here was carried on carefully. We had a great number of checks on our results, and we feel that those we present are accurate and trustworthy.

My conclusions are as follows:

1. Among the various hearing aids of different manufacture on the market having as components a carbon microphone, a carbon amplifier and an ear-fitting receiver, there are important differences in the amount of amplification produced and tremendous differences in their intelligibility ratings.

2. The differences in performance do not depend measurably on the observed nonuniformity of response. In consequence, furnishing frequency response curves to the otologist with each hearing aid would be of no value.

3. Of greater importance is a wide range of response (as a minimum, 200 to 3,000 cycles per second), freedom from singular peaks of amplication and sufficient amplification.

4. Of paramount importance is the actual aid the user obtains in interpreting speech and sentences correctly.

5. Hearing aids having a low intelligibility rating were also found to produce the greatest volume of noise by-products due to nonlinear distortion. It is concluded that these noise components are the principal cause of the poor intelligibility.

6. Portable hearing aids consisting of a carbon microphone and receiver only are largely ineffective because of insufficient amplification.

7. At present probably the best means of determining the usefulness for a particular person of a carbon microphone hearing aid of known merit is the discrete sentence intelligibility test.

8. Tests made with bone conduction oscillators indicated that their relative merit is not appreciably affected by the substitution of bone conduction for air conduction when used on persons with normal bone conduction.

HERPES ZOSTER OTICUS, WITH A REPORT OF THREE CASES. DR. FREDERICK T. HILL, Waterville, Maine.

Herpes zoster oticus is a rare condition. A review of hospital statistics for the past ten year period shows approximately the same number of cases as reported by Hunt in 1907. In some cases, especially when it is of the simplest type, the condition may be overlooked or wrongly diagnosed. Present conceptions of herpes zoster point to its being a specific infection, due to a filtrable virus, which involves all nerve structure, rather than a ganglionitis in any limited sense. All sorts of variations in the clinical picture have been noted. While the prognosis is generally good, hearing is the function most likely to be permanently damaged. There may be involvement of the middle ear due to secondary infection of bacterial origin, superimposed on the virus infection. This may alter the usual clinical picture of otitis media somewhat. Roentgen ray therapy may be beneficial, especially in the alleviation of pain. This was used in 2 of my cases with apparent success. The same clinical picture may be caused by various causes. Trauma, chronic irritation or pressure on a nerve trunk or ganglion may simulate true zoster. Years ago Grindon defined the latter condition as "zosteroid." The literature on the subject since Hunt's contribution in 1907 is reviewed. Three cases are reported.

Directory of Otolaryngologic Societies *

FOREIGN

Collegium Oto-Rhino-Laryngologicum Amicitiæ Sacrum

President: Prof. Gunnar Holmgren, Karolinska Mediko-Kirurgiska Institutet, Stockholm, Sweden.
Secretary: Prof. Dr. C. E. Benjamins, Verlengde Heereweg, 143 Groningen, The Netherlands.

NATIONAL

American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. Robert F. Ridpath, 1737 Chestnut St., Philadelphia.
Secretary: Dr. Gordon B. New, Mayo Clinic, Rochester, Minn.
Place: Atlantic City, N. J. Time: June 7-11, 1937.

American Academy of Ophthalmology and Otolaryngology

President: Dr. Frank E. Burch, 408 Peter St., St. Paul.
Executive Secretary: Dr. William P. Wherry, 1500 Medical Arts Bldg., Omaha.
Place: Detroit.

American Bronchoscopic Society

President: Dr. Joseph C. Beck, 185 N. Wabash Ave., Chicago.
Secretary: Dr. Lyman Richards, 319 Longwood Ave., Boston.

American Laryngological Association

President: Dr. W. B. Chamberlain, 10515 Carnegie Ave., Cleveland.
Secretary: Dr. James A. Babbitt, 1912 Spruce St., Philadelphia.

American Laryngological, Rhinological and Otological Society, Inc.

President: Dr. George M. Coates, 1721 Pine St., Philadelphia.
Secretary: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester, N. Y.
Place: Hotel Traymore, Atlantic City, N. J. Time: June 3, 4 and 5, 1937.

SECTIONS:

Eastern.—Chairman: Dr. D. C. Jarvis, Quarry Bank Bldg., Barre, Vt.
Place: Boston. Time: Jan. 7, 1937.
Southern.—Chairman: Dr. Charles D. Blassingame, P. & S. Bldg., Memphis, Tenn.
Place: Memphis, Tenn. Time: Jan. 13, 1937.
Middle.—Chairman: Dr. Alfred Lewy, 25 E. Washington St., Chicago.
Place: Chicago. Time: Jan. 11, 1937.
Mid-Western: Dr. Frederick A. Figi, 436 Tenth Ave., Rochester, Minn.
Place: Chicago. Time: Jan. 11, 1937.
Western.—Chairman: Dr. David R. Higbee, 3245 Fourth Ave., San Diego, Calif.
Place: San Diego, Calif. Time: Jan. 30 and 31, 1937.

American Otological Society

President: Dr. Edmund Prince Fowler, 140 E. 54th St., New York.
Secretary: Dr. Thomas J. Harris, 104 E. 40th St., New York.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.